

## PART II: THE AFFECTED ENVIRONMENT

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## PART II: THE AFFECTED ENVIRONMENT

### A. Regional Context

#### 1. Sanctuary Study Area Location

A Western Washington Outer Coast site was included on NOAA's original Site Evaluation List (SEL) established in 1983 (48 FR 24296, May 31, 1983). This SEL consists of 29 marine sites with high natural resource values that were identified and recommended to NOAA by regional resource evaluation teams. The SEL Western Washington Outer Coast site extends from Duntze Rock (north of Tatoosh Island on the northwestern tip of the state of Washington), 90 miles (145 km) southward along the coast to Point Grenville. The offshore boundary is contiguous with the boundary established for the Washington Islands National Wildlife Refuge, 2 to 3 miles (3.2-4.8 km) offshore. The Sanctuary study site encompasses approximately 225 square miles (169 nm<sup>2</sup>, or 576 km<sup>2</sup>) (Figure 3, p. I-11).

The 1988 amendments to the MPRSA (PL 100-627, November 7, 1988), direct the Secretary of Commerce to issue a notice of designation with respect to the Western Washington Outer Coast (proposed herein as the "Olympic Coast") National Marine Sanctuary not later than June 30, 1990 (section 205). In report language accompanying this legislation (H. Rep. No. 4210, 100th Cong., 1st. Sess., 1988), Congress noted that the boundaries of the area identified in the SEL may fail to provide an adequate buffer, and directed NOAA to use the SEL boundaries only very generally as a point from which to embark upon a more detailed public review and comment process which would lead to the development of various boundary options. NOAA was directed by Congress to consult extensively with state agencies, local government officials, marine scientists, and the public in carrying out the designation process and establishing specific boundaries.

In response to the Congressional directive, NOAA met with several government officials and marine scientists, and conducted four public scoping meetings in Washington State during April 1989. NOAA was strongly urged by tribal, state and local governments, other Federal agencies, private interest groups, and citizens to expand the area to be evaluated for sanctuary designation; specifically, areas south of Point Grenville to the Columbia River, and offshore to the edge of the continental shelf (defined herein as the 100 fathom depth contour). The heads of submarine canyons incising the shelf, and a highly productive fishing area adjacent to the head of Juan de Fuca Canyon, known as "the plain", were recommended for study. It was also suggested that consideration be given to extending the northern sanctuary boundary to the international boundary between Canada and the United States to promote and facilitate a potential

"international sanctuary" at some future time. Some comments on the Draft Environmental Impact Statement/Management Plan (DEIS/MP) issued in September 1991, suggested that an eastern boundary be established within the Strait of Juan de Fuca. The total study area for the proposed Sanctuary evaluated by NOAA is, therefore, quite extensive compared to the original SEL site description, and covers approximately 4,155 nm<sup>2</sup> (14,249 km<sup>2</sup>) (Figure 4).

The Olympic coast extends for approximately 150 miles from Cape Flattery in the north, southward to Cape Disappointment at the mouth of the Columbia River. The southernmost portion of the coastline is characterized by estuaries, wetlands, long sandy beaches, and dunes. North of Point Grenville the coastline is more rugged and rocky with high cliffs and sea stacks.

The area selected by NOAA for inclusion in the proposed Olympic Coast National Marine Sanctuary (i.e., NOAA's "preferred boundary option") is similar to that proposed in the DEIS/MP with slight variations to the shoreward boundary (Figure 5). The preferred boundary extends from Koitlah Point northward across the Strait of Juan De Fuca to the U.S./Canada international boundary where it continues seaward to the 100 fathom isobath, and southward along the coast to the southern border of the Copalis National Wildlife Refuge off of Copalis Beach, thus incorporating the entire northern rugged, rocky coastline. This sparsely populated 135 mile stretch of coast remains one of the few relatively undeveloped and pristine coastlines in the United States. In waters adjacent to Federally owned lands, the boundary of the proposed sanctuary extends landward to the higher high water line, and across the mouths of rivers and streams. When adjacent to Indian reservations and State lands, the Sanctuary boundary extends to the lower low water line.

The seaward extent of the sanctuary boundary generally follows the 100 fathom isobath except where it cuts across the heads of the Juan de Fuca, Quinault and Nitnat Canyons. The northern boundary encompasses the productive fishing areas known as "the plain," and Swiftsure Bank. The total surface area of the sanctuary is approximately 2,500 nm<sup>2</sup> (8577 km<sup>2</sup>).

Characteristic of the coastal area of the proposed Sanctuary are rugged headlands and cliffs; sea stacks and sea arches; tidepools; hundreds of small offshore islands, rocks, and reefs; and sand and cobble beaches. Nutrient-rich waters and diverse habitat types result in an abundance and diversity of marine species of algae, invertebrates, finfish, shellfish, birds, and marine mammals. Commercial and recreational fisheries for salmon, groundfish, razor clams, and dungeness crab within the area contribute to the economy of Washington state and the nation. Popular recreational diving sites are located throughout

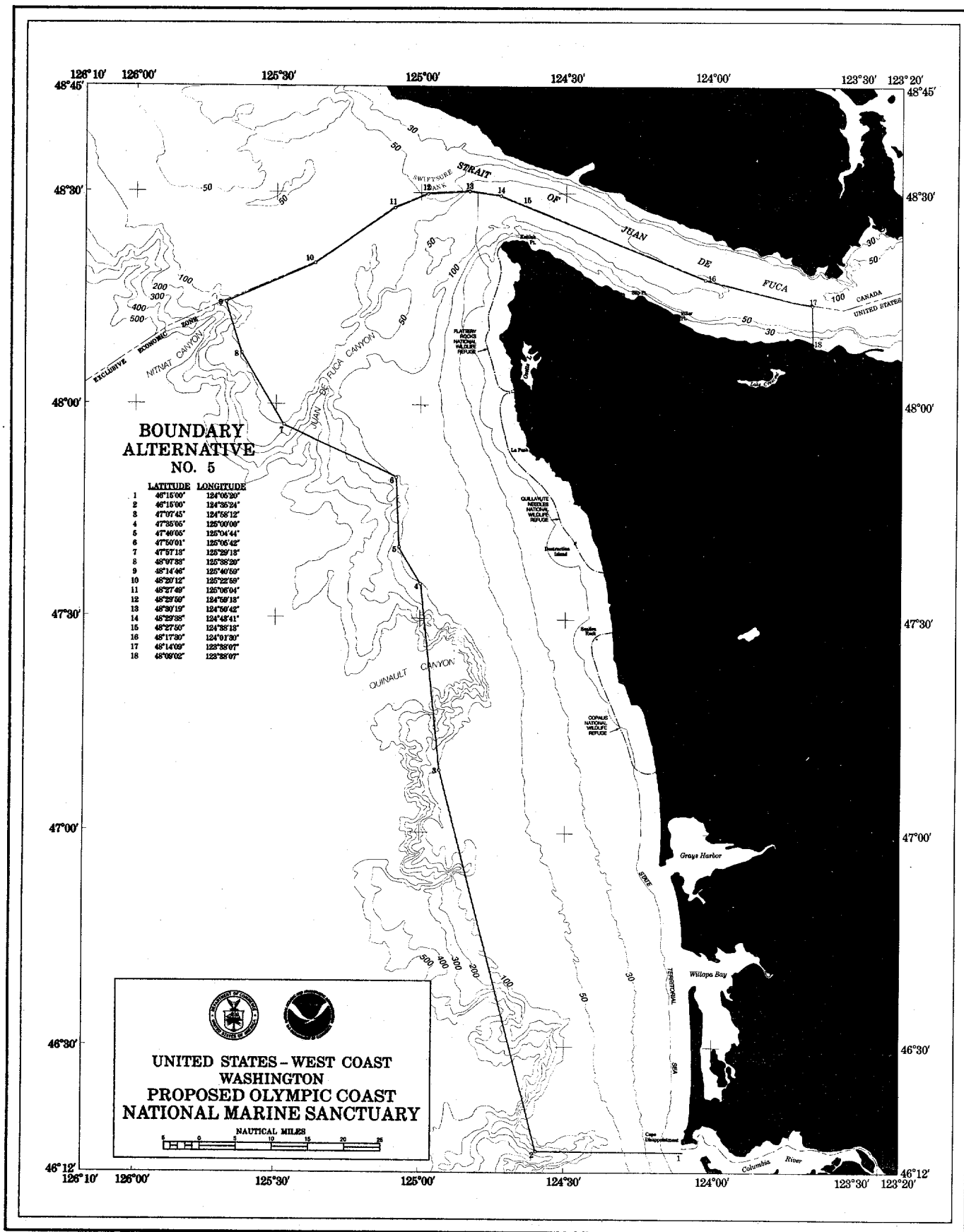


Figure 4. Study Area for the Proposed Olympic Coast National Marine Sanctuary.

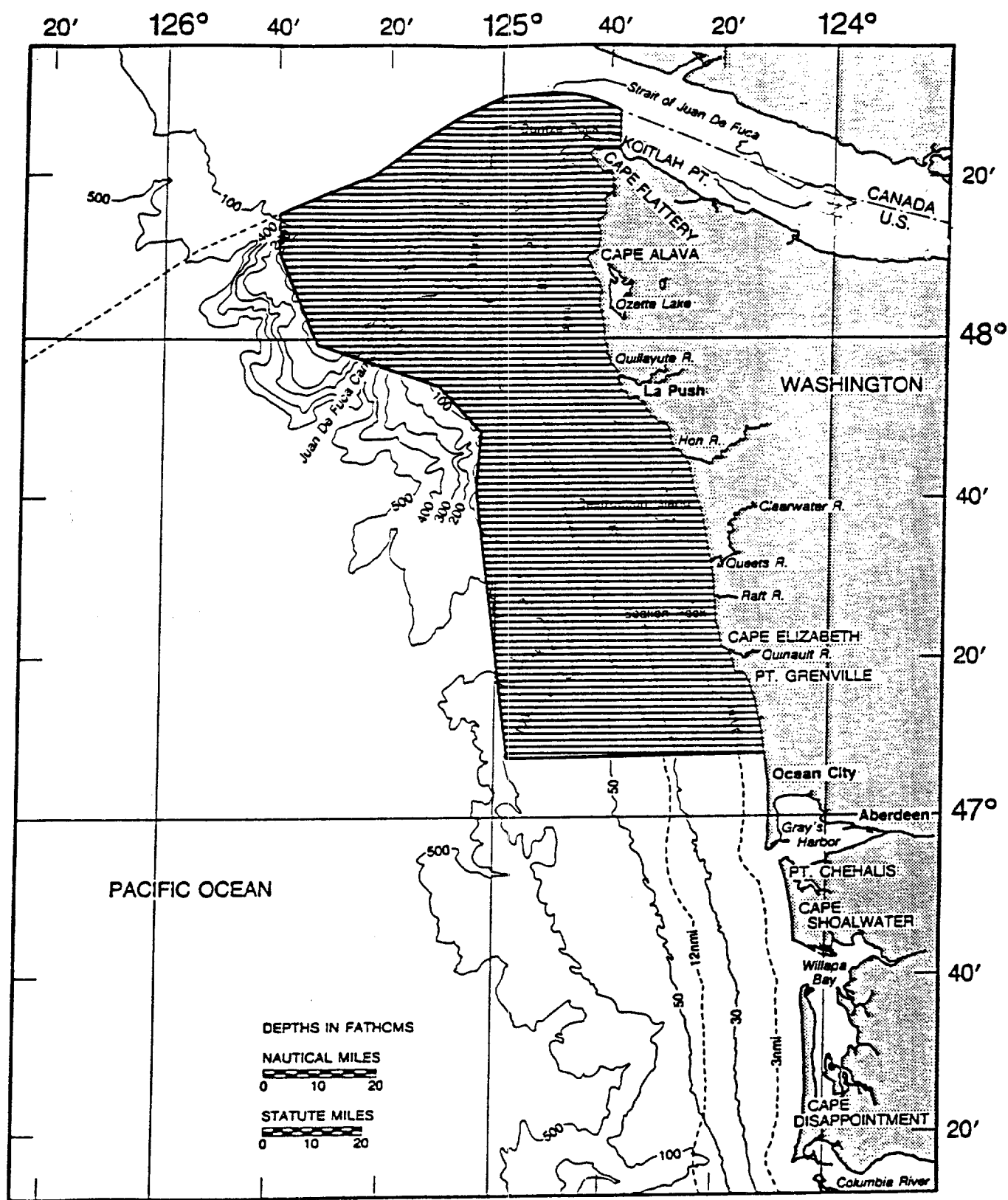


Figure 5. NOAA's Preferred Boundary Alternative.

the Strait of Juan de Fuca.

## 2. Socio-demographic Profile and Land Use

Most of the land area adjacent to the sanctuary study area is protected and sparsely populated. There are four Indian Reservations from Neah Bay to Moclips and more populated non-tribal communities bordering Grays Harbor and Willapa Bay. The land not encompassed by reservations or non-tribal communities on the outer coast, and offshore rocks and islands are largely protected by the NPS and the USFWS (both within the Department of Interior). Olympic Coast designations of national significance include migratory bird sanctuaries, wildlife refuges, wilderness areas, a Biosphere Reserve, and a World Heritage Site (Figure 6). Most of the remaining coastal lands along the outer coast not managed under Federal authority or within reservations are state public use areas (i.e., 74% of Clallam and Jefferson counties are under public ownership).

Small residential communities dot the Strait of Juan de Fuca between Neah Bay and Observatory Point including Joyce, Clallam Bay, and Sekiu. Public beaches abutting privately-owned land border much of the Strait resulting in few access points to the Strait. Clallam County has developed a park at Tongue Point and Observatory Point, and the Washington State Department of Natural Resources has developed a park at the Lyre River.

Population density in the counties adjacent to the study area is, and projected to remain low and relatively static (Appendix C, Figure 8). While the population of the State of Washington is expected to double from its 1960 level by the year 2010, the coastal counties in the northern extent of the study area, Clallam and Jefferson counties, are expected to increase by only 30 percent. Grays Harbor and Pacific counties, bordering the southern portion of the study area, are projected to increase even less, with some areas actually projected to experience a population decline, from -20 to 14 percent. The overall population density of the four coastal counties bordering the sanctuary study area is projected to be only between 0-49 persons per square mile by the year 2010 (Culliton et al., 1990).

The economy in the coastal region is inextricably linked to its natural resources, based primarily upon seafood, timber harvesting, pulp and paper production, and tourism. This is reflected in a number of socioeconomic indicators including a high reliance on manufacturing jobs compared to other coastal communities, high unemployment, low property values compared to those of the rest of the coastal U.S., and fewer construction permits. The tourist industry generates approximately \$560 million annually from visits to the Olympic National Park. Of the estimated 3.5 million visits annually to the Park, approximately one third are to the coastline (SAB, 1984).

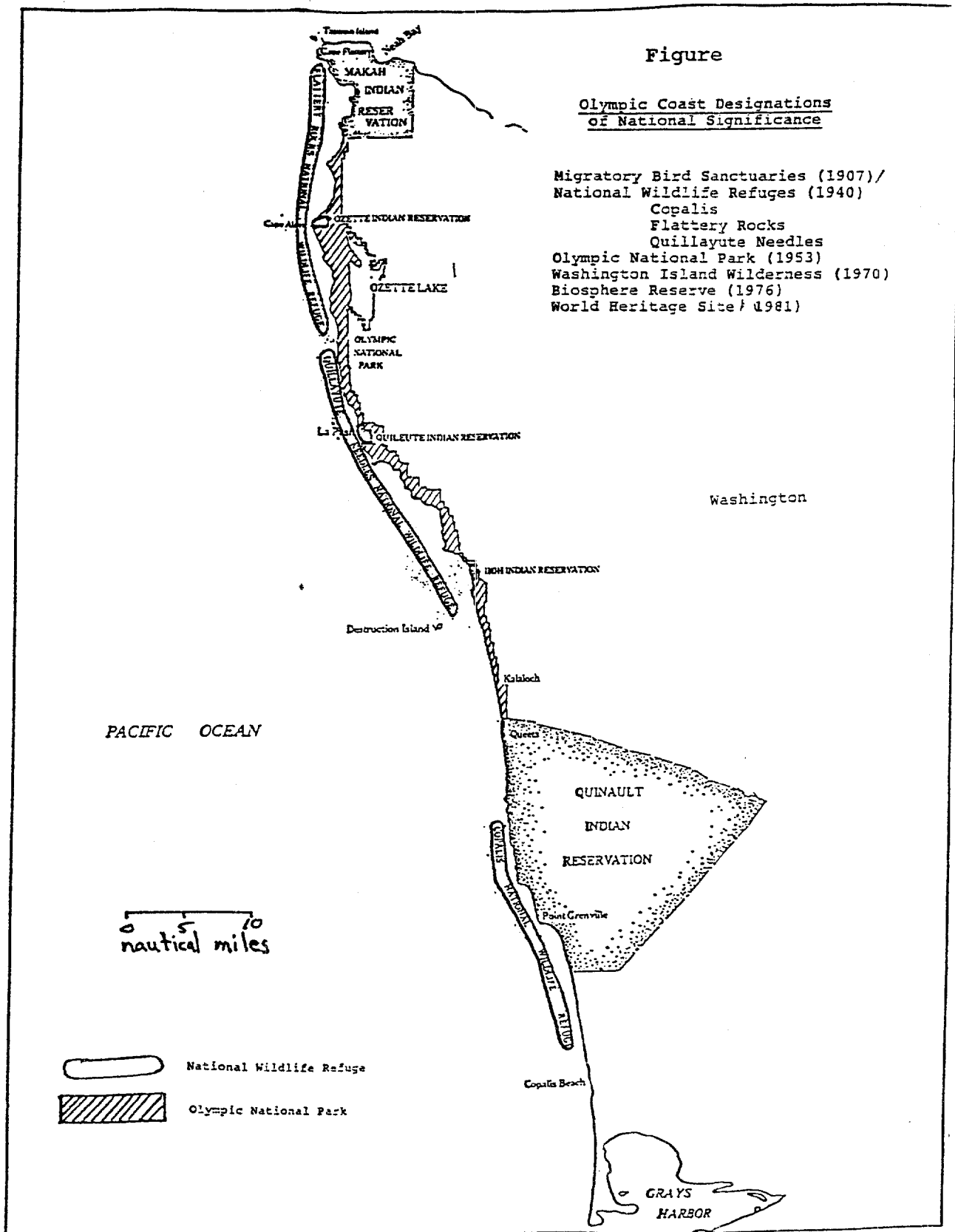


Figure 6. Olympic Coast Designations of National Significance.

Low population densities along the coast contribute to the relatively pristine nature of the outer coast and Strait of Juan de Fuca. Pollution sources such as agricultural and urban runoff, and domestic and industrial point sources are minimal. Likewise, a lack of shoreline development has enabled wildlife habitats to remain largely undisturbed. However, there are indications that excessive runoff resulting from timber operations are stressing coastal habitats.

Because of the presence of the Olympic National Park, forest lands dominate land use within all four coastal counties (Appendix C, Figure 1). Agriculture and wetlands are the next two most intensive land uses around Willapa Bay and Grays Harbor. Freshwater inflow into the proposed sanctuary watershed is relatively small compared to other areas of the contiguous West Coast. However, volumes of freshwater flow per square mile of drainage basin are high because the land, characterized by small drainage basins and steep terrain, experiences high rainfall (over 200 inches per year in some areas) (Rohmann, 1990).

### Tribal Economies

Four Indian reservations are located on the outer coast of Washington State: 1) the Makah, located on the northwestern tip of the Olympic Peninsula; 2) the Quileute, located at La Push; 3) the Hoh, situated at the mouth of the Hoh River; and 4) the Quinault, located between Queets and Moclips. These four tribes are Federally recognized Indian Nations pursuant to the Steven's Treaties of 1855 which include the Treaty of Neah Bay (January 31, 1855. 12 Stat. 939) with the Makah Indians and the Treaty of Olympia (July 1, 1855. 12 Stat. 971) whose signatories include the Quinault, Quileute and Hoh Tribes (Appendix D).

The Ozette Reservation is a separate reservation inhabited historically by the Ozette Tribe. It is of cultural importance to the Quileute, Hoh and Makah Tribes, each of which now incorporate some Ozette ancestry, and each of which have historically fished and traded with the Ozette. Both the Quileute and Makah Tribes have asserted their right of access to the Ozette Reservation (Penn, 1992).

The following discussion presents: 1) an overview of the four Indian Tribes and their historical dependence on ocean resources; 2) the legal status of Treaty Tribes and their treaty-secured rights; and 3) current activities occurring on, or proposed for, the four Indian reservations. Description of the tribes and their legal status is extracted predominately from two Minerals Management Service publications (MMS, 1990; 1991) and by representatives of the respective tribes.

## The Four Coastal Tribes and Historical Dependence on Marine Resources

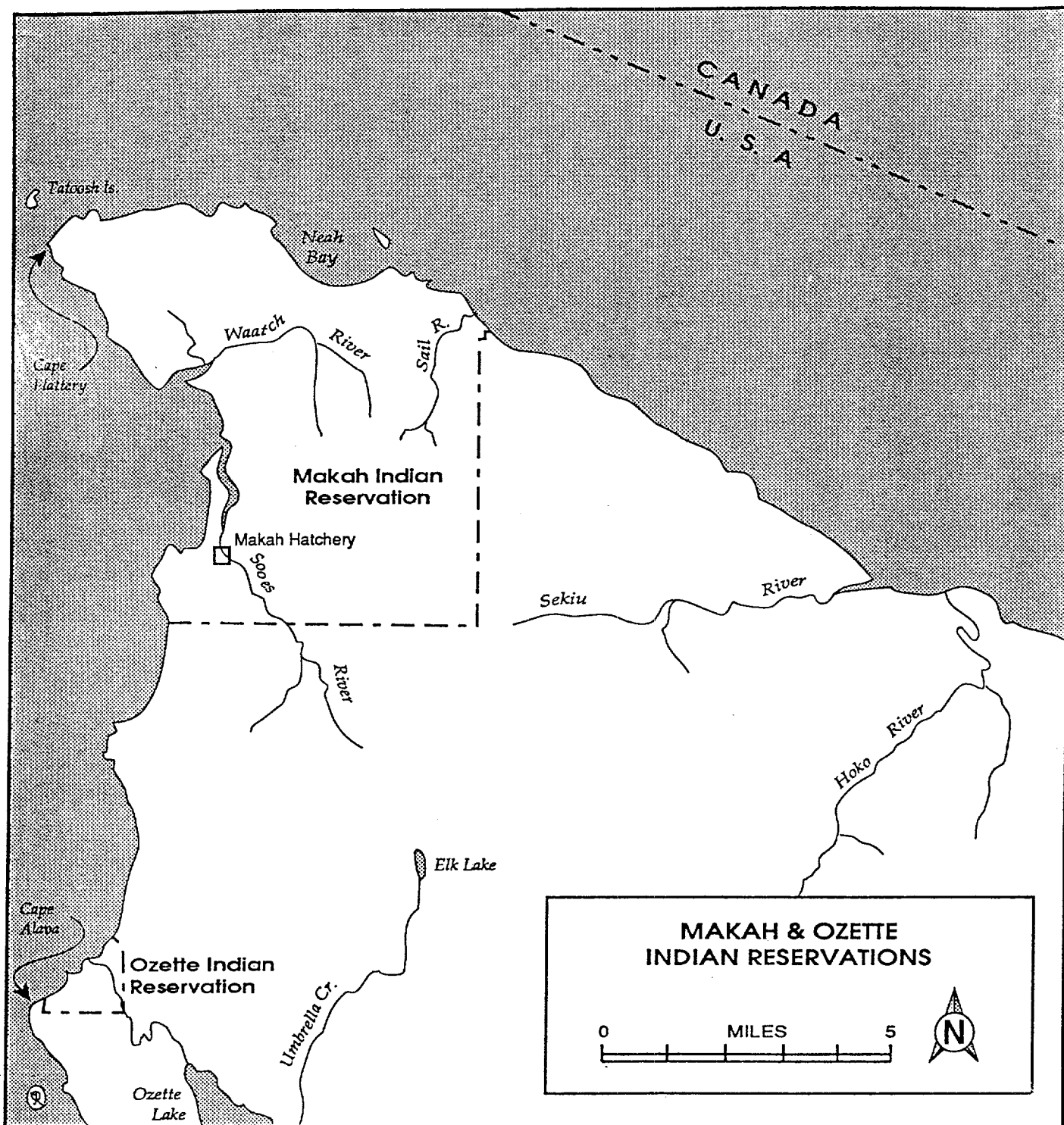
### **Makah Indian Nation**

The Makah Tribe differs from their Salish neighbors in that they are of Nooktan origin. Their main settlements at Neah Bay were set aside as a reservation pursuant to the Treaty of Neah Bay and subsequent Executive Orders, and they are governed under an Indian Reorganization Act constitution adopted in 1936. The Makah reservation is located on the northwestern-most tip of the Olympic Peninsula (Figure 7). It encompasses 44 square miles of land bounded by the Pacific Ocean to the west and the Strait of Juan de Fuca to the north. The Ozette Reservation, 10 miles south of Neah Bay is part of the Makah Reservation, with the Olympic National Park managing the contiguous shoreline between the two components of the Reservation.

Neah Bay is one of the largest and most accessible communities on the Olympic Peninsula with a year-round population of 1,400. It suffers from limited economic opportunities, and chronic and seasonal unemployment of over 16% and 50%, respectively (MMS, 1991). There has been a steady increase in the on-reservation portion of the population from 1960-1980 attributed partly to a higher birth rate, and expanded on-reservation economic opportunity subsequent to, and as a result of the Court's decision in United States v. Washington, 384 F. Supp. 312 (W.D. Wash. 1974), aff'd, 520 F.2d 676 (9th Cir. 1975), commonly referred to as the "Boldt Decision". As a result, the on-reservation Makah population age structure is younger than that of Washington State as a whole.

Historically, the Makah's relied on the marine resources for approximately three fourths or more of their diet which was comprised predominately of halibut and whale. Primary fishing and whaling grounds extended up to 50 miles seaward of Cape Flattery over La Perouse Bay and Swiftsure Banks. Other food fisheries included salmon, squid, skates, sea urchins, mussels, barnacles, crabs, sea slugs, periwinkles and limpets. Gadoid fish were consumed including true cod, lingcod, rockcod, sablefish, sculpins and rockfish. Porpoises, seals, sea-lions, otters, and seabirds were also hunted. Traditional salmon fishing was concentrated in the Sekiu and Hoko rivers just to the east of Neah Bay on the Strait.

After the 1880's, the Makah Tribe experienced dramatic changes in their economy. Increased exploitation of seals and halibut by American fishing fleets forced the Makah's to rely more heavily on salmon and other nearshore fishery resources. By 1942, fishing (approximately 1/3 for halibut) accounted for only a little more than 25 percent of the Makah's income. Today, marine resources are vital to the Makah Tribe for commercial and



subsistence purposes. Over 60 percent of Tribal members actively fish and 75 percent of Tribal households are directly or indirectly dependant on fisheries for their economic survival. Many tribal members continue to harvest other marine resources, including shellfish and marine mammals for subsistence (MMS, 1991). A more complete list of ocean and coastal resources utilized by the Makah is presented in Appendix E.

### **Quileute Tribe**

The Quileute Reservation is located approximately 36 miles south of Cape Flattery (Figure 8). Their reservation encompasses one square mile of land at La Push. Approximately 450 of the 723 persons enrolled in the Quileute Tribe in 1990 live on the reservation. The unemployment rate on the reservation is approximately 81 percent, with 92 percent of those employed earning less than \$7,000 annually.

The Quileute are ethnically and linguistically distinct from their Tribal neighbors who are of Nootkan and Salish origin with two exceptions: 1) the Hoh, part of the Quileute Tribe until recent times, incorporates the same language and ethnic characteristics; and 2) the recently extinct Chinacum Tribe of the Olympic Peninsula and Port Townsend Area, was also known to have spoken essentially the same language as the Quileute Tribe (Penn, 1992). The Quileute language is one of only five languages in the world lacking nasal sounds. The Quileute and Hoh Tribes are closely related aboriginally, but have functioned increasingly as distinct legal entities since the early part of the century. Although the Treaty of Olympia provided for a single reservation for both the Quileute and Hoh Tribes, two small reservations were set aside for each by Executive Orders of September 11, 1893, and February 19, 1889, respectively. The Quileute adopted an Indian Reorganization Act Constitution in 1936, and the Hoh in 1969.

The main Quileute winter village was historically located at La Push. The Quileute harvested salmon, smelt, bass, ocean perch, cod, rockcod, redcod, lingcod, halibut, flounder and other flatfish, bullheads, rays, octopus, shark, herring, sardine, and sturgeon. They hunted hair and fur seals, sea lions, sea otters, porpoise, and whale, and gathered butter clams, razor clams, rock oysters, mussels, acorn and goose-neck barnacles, sea urchins, anemones, slipper-shells and crabs. Among the seabirds harvested were ducks, geese, white-crested cormorant, brandt, gulls, puffins, auklets, and loons.

As a result of increasingly restricted access to marine mammals and terrestrial resources such as deer and elk by Federal and state laws, the coastal tribes became more dependent upon fishing for commercial and subsistence purposes. By 1944, fishing accounted for approximately two thirds of the Quileute

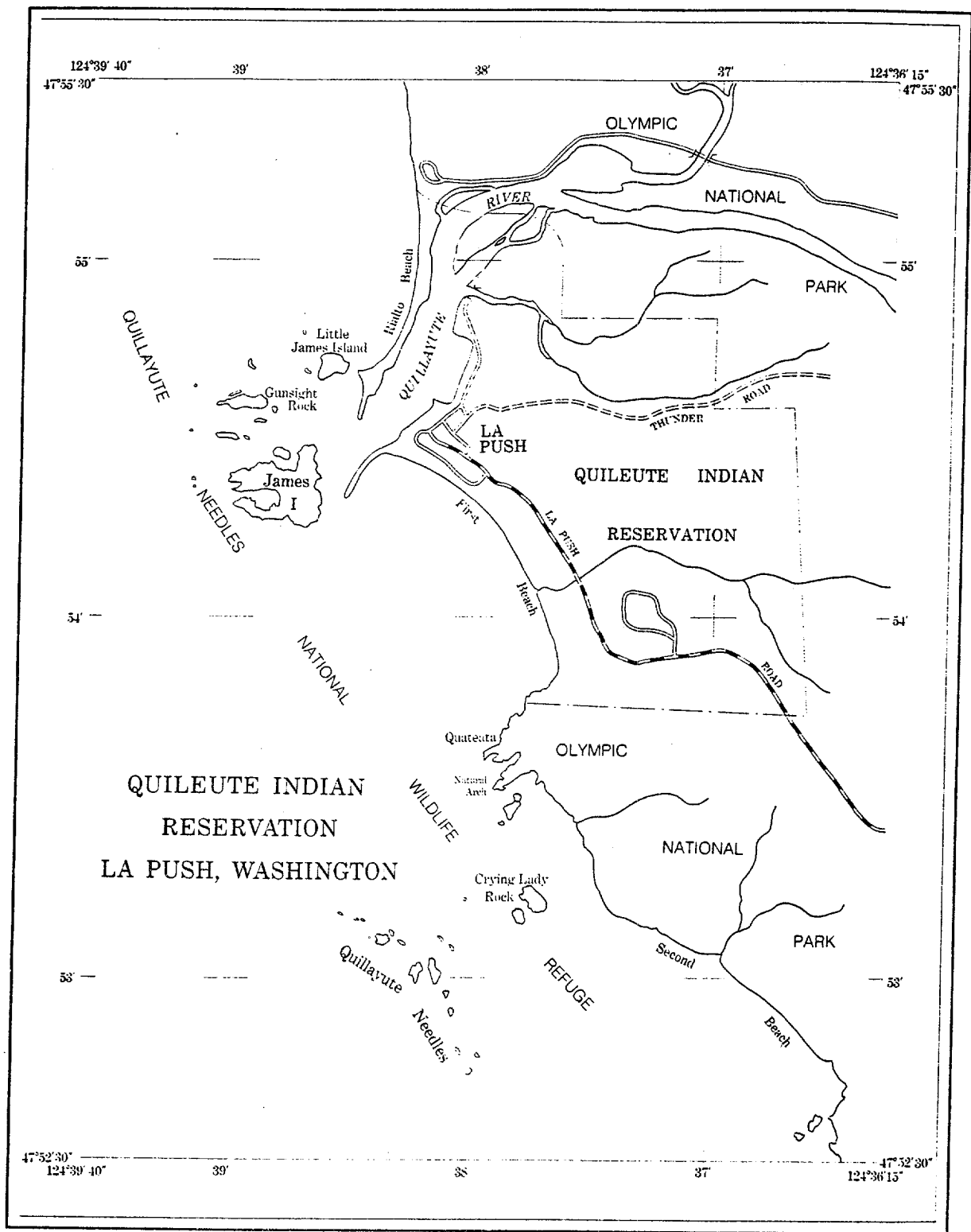


Figure 8. Location of the Quileute Indian Reservation (MMS, 1991).

Tribe's earned income, with the remainder derived from fur trapping, crafts, some cattle-raising and wage work, chiefly in logging and for the Forest Service. Resources currently harvested by the Quileute are listed in Appendix E. Shellfish and other shoreline resources play a year-round role in sustaining the Quileute people (MMS, 1991).

### **Hoh Indian Tribe**

The main Hoh village is located at the mouth of the Hoh River on a small reservation encompassing approximately 480 acres (Figure 9). The reservation extends along the coast for about one mile. There is no protected harbor either at the river mouth or elsewhere on the reservation. According to a 1989 report by the Bureau of Indian Affairs, 94 of 120 persons enrolled in the tribe live on or near the Reservation. Unemployment is approximately 53 percent with 82 percent of employable persons earning less than \$7,000 annually.

The Hoh historically harvested salmon halibut and black bass, clams and smelt. They also harvested whales near Destruction Island. Their current economic opportunities are bleak with most Hoh families subsisting from oceanic and coastal resources. Today, the Hoh consume more ocean and shoreline resources per household than any other Washington coastal Tribe. The resources upon which the Hoh depend are listed in Appendix E. Other economic activities occurring on the Hoh reservation include the production of native crafts and a limited amount of timbering.

### **Quinault Indian Nation**

The Quinault Reservation was established by Executive Order in 1873. The Tribe functions under an Indian Reorganization Act constitution adopted in 1965. The reservation, encompassing approximately 200,000 acres extends 26 miles along the Pacific Coast (Figure 10). The two principle villages are Taholah and Queets. A third village on the reservation, Amanda Park, is populated by non-Indians. The total population on the Quinault reservation is approximately 2260 (MMS, 1991). The per capita income on the Quinault Reservation in 1988 was \$3,182 compared to \$7,446 in Grays Harbor County. Approximately 32.6 percent of families on the Quinault reservation are below the poverty level compared to 10.5 percent of families in Grays Harbor County (MMS, 1991).

The Quinault are speakers of Chinookan, Salish or Chemakuan. The present Quinault Reservation contains the ancient lands of two distinct tribes, the Quinault and the Queets. Historically, marine resources harvested were salmon, smelt and candlefish, halibut, cod, rock cod, sea bass, and soles, razor clams, mud clams, rock oysters, black-shelled mussels, slipper-shells, sea

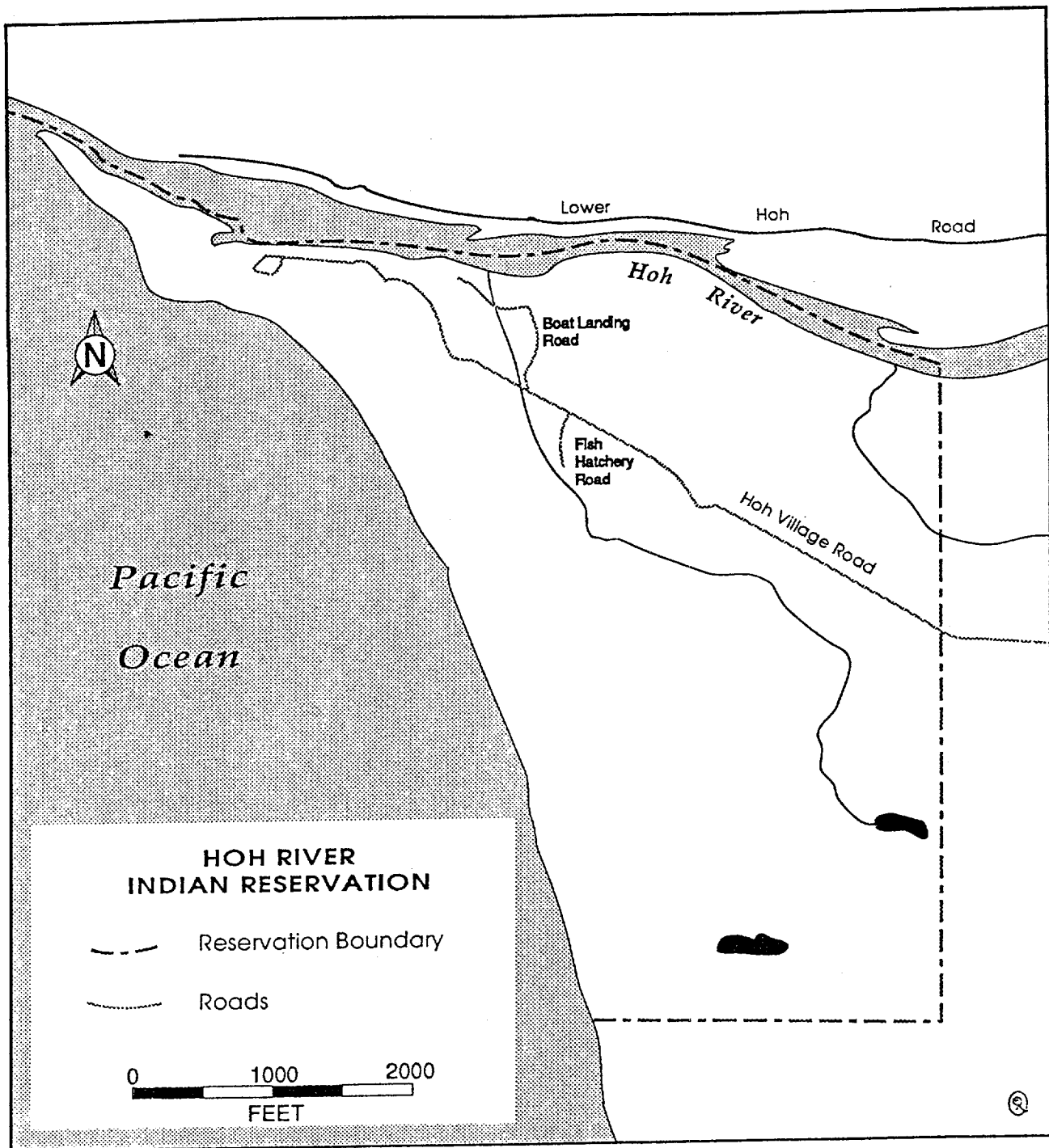


Figure 9. Location of the Hoh Indian Reservation (MMS, 1991).

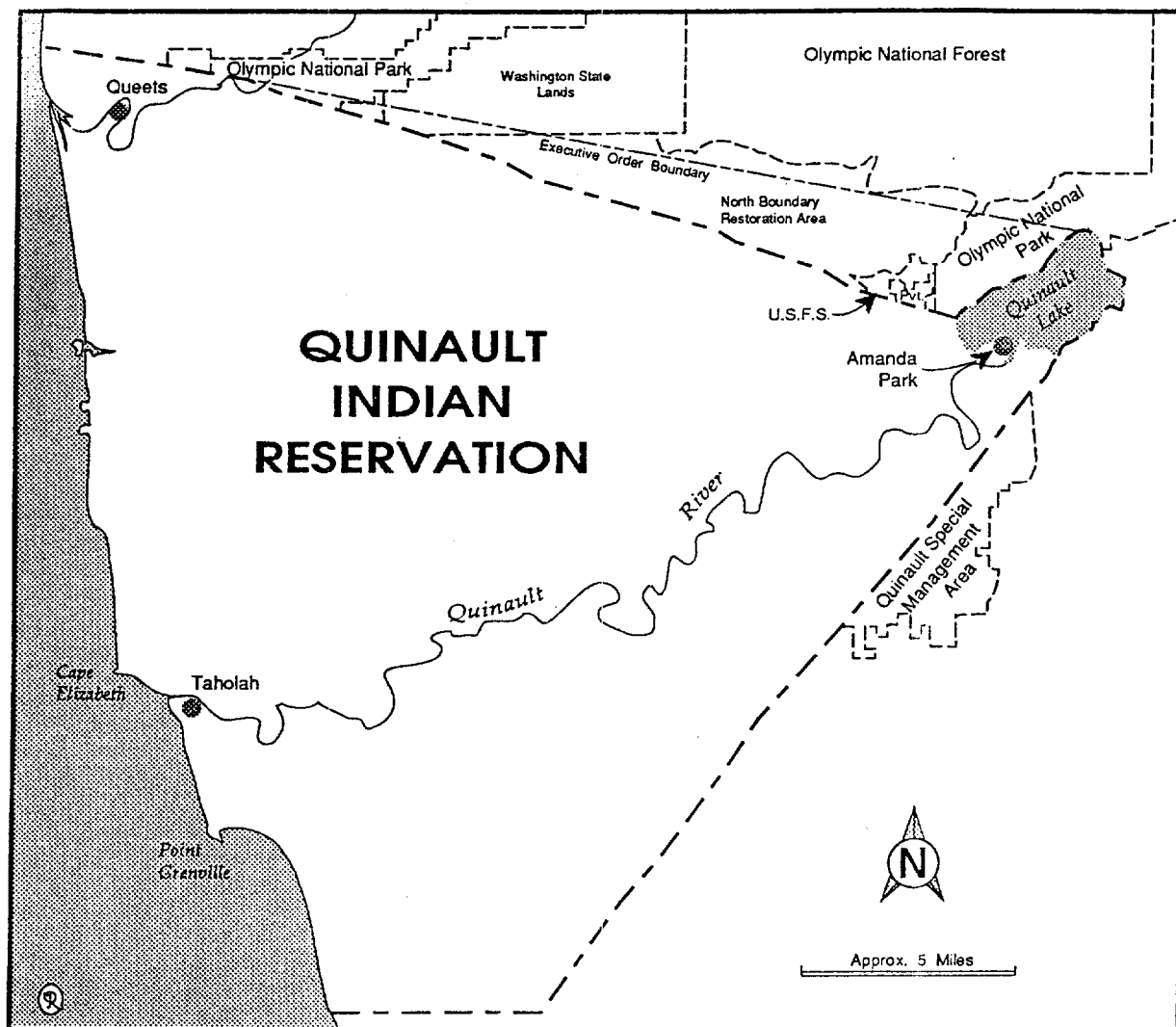


Figure 10. Location of the Quinault Indian Reservation (MMS, 1991).

anemones and crabs, flounders, herring, seals, sea lions, whales, and sea otters. Birds harvested included ducks, geese, gulls, and loons and their eggs. Seaweed was also harvested for food.

By the 1870's the Quinault were economically integrated into European society. They were engaged in a variety of wage-earning occupations such as seal hunting, and employed by oyster, fishing and logging companies. Today, salmon has become the commercial mainstay of Quinault fisheries, in addition to halibut, lingcod, black bass, other rockfish, smelt, flounder, perch, sturgeon and razor clams. A more complete list of ocean resources harvested by the Quinault is provided in Appendix E. Virtually every Quinault tribal member derives some benefit from the fishery resources through participation in ceremonies, distribution of fish within families, and sharing of fish among extended families and friends. The Tribe is pursuing a strategy of vertical integration to increase the benefit return from ocean resources. A seafood processing facility at Taholah depends both upon tribal catch and fish purchases from off-reservation suppliers.

### Treaty Rights and Legal Status

The Tribes have a unique legal status under which they enjoy a collective interest in lands and natural resources quite different from the property rights accorded to others. By entering into treaties with the tribes, the United States accepted a fiduciary duty to protect all of the rights which the treaty secured, including marine hunting and fishing rights. There is "an extensive body of cases holding that when the federal government enters into a treaty with an Indian tribe..., the Government commits itself to a guardian-ward relationship with that tribe." Joint Tribal Council of Passamaquoddy v. Morton, 528 F.2d 370, 379 (1st Cir. 1975). This fiduciary duty, known as the federal trust responsibility, extends to all federal agencies. Pyramid Lake Paiute Tribe v. United States, 898 F.2d 1410, 1420 (9th Cir. 1990). In addition, it requires that federal agencies seriously consider and protect Indian rights and interests to the fullest extent possible. Northern Cheyenne Tribe v. Hodel, 12 Ind. L. Rptr. 3065 (D. Mont. 1985). The Federal government, however, is not obligated to provide particular services or benefits, nor to undertake any specific fiduciary responsibilities in the absence of a specific provision in a treaty, agreement, executive order, or statute. Havasupai Tribe v. U.S., 752 F. Supp. 1471 (D. Ariz. 1990), citing Vigil, 667 F.2d at 934; North Slope Borough v. Andrus, 642 F. 2d 589, 611 (D.C. Cir. 1980); Gila River Pima-Maricopa Indian Community, 427 F.2d 1194, 190 Ct.Cl. 790 (1970).

The Treaty of Neah Bay and the Treaty of Olympia expressly reserved, among other things, each Tribes' right to continue to fish in its "usual and accustomed fishing grounds and stations." The Treaty of Neah Bay differs from the Treaty of Olympia in that

it secures for the Makah Indian Nation the "right of taking fish and of whaling or sealing at usual and accustomed grounds and stations..."(Article 4, Treaty of Neah Bay, 1855). The addition of whaling in the Treaty of Neah Bay addresses the Makah's historical dependence on whaling for subsistence, cultural and ceremonial purposes.

In addition to reserving the right to fish and whale at usual and accustomed fishing areas, the Treaties also secure the right of access to Tribal lands for the Treaty Tribes. Article 2 of each Treaty states that "...said tract shall be set apart, and so far as necessary surveyed and marked out for their exclusive use; nor shall any white man be permitted to reside upon the same without permission of the said tribe and of the superintendent or agent..." Thus, access to Tatoosh Island and the Ozette site by the Makah Tribe is secured by the Treaty of Neah Bay.

The post-treaty history of Northwest Indian fishing rights has been contentious and complex. With increasing exploitation of marine mammals, pinnipeds and fish by European settlers, the Treaty Tribes fought to maintain their treaty-secured right of access to marine resources in the courts. In 1905 the United States Supreme Court interpreted the Treaties securing the right of treaty tribes to fish to be "not a grant of rights to the Indians, but a grant of rights from them,--a reservation of those not granted." United States v. Winans, 198 U.S. 371, 384 (1905).

Aboriginal and treaty-secured rights can only be abrogated if there is "clear evidence that Congress actually considered the conflict between its intended action on the one hand and Indian treaty rights on the other, and chose to resolve that conflict by abrogating the treaty" United States v. Dion, 476 U.S. 734, 739-40 (1986). Regulations which restrict the exercise of treaty-secured hunting and fishing rights are lawful only if they: 1) are "reasonable and necessary" to "prevent demonstrable harm" to a harvested species or stock; and 2) are the least restrictive alternative for achieving this purpose. (United States v. Washington, 384 F. Supp. 312, 342, 415 (W.D. Wash. 1974), aff'd, 520 F.2d 676 (9th Cir. 1975)).

Two significant legal decisions have addressed the extent to which state and Federal regulatory measures were justifiable for conservation purposes. In 1942 the United States Supreme Court struck down license fees for tribal members as unrelated to the conservation of fish, and hence contrary to the intent of the treaties. Tulee v. Washington, 315 U.S. 681 (1942). In 1974, the landmark "Boldt Decision" held that Indian tribes of Puget Sound and coastal Washington have the right to an opportunity to take up to 50 percent of the total number of harvestable salmonids, as well as the right to regulate their own fishers. United States v. Washington, 384 F. Supp. 312 (W.D. Wash. 1974), aff'd, 520 F.2d 676 (9th Cir. 1975). Non-salmonid fisheries may

eventually be brought within the same legal regime because Indian tribes in Washington State have launched a challenge against the State's shellfish harvesting regulations (MMS, 1991).

#### Current and Future Activities

Current activities occurring on and/or planned for the reservations adjacent to the proposed study area include timbering, harbor development and maintenance, an increased emphasis on attracting tourism, and the preservation of culturally significant and wilderness areas. The tribes seek to promote economic development on the reservations to alleviate unemployment and poverty, enhance their ability to provide basic public services and facilities, and further the joint tribal-Federal goal of tribal self-sufficiency (MMS, 1991).

Timbering is an important economic activity on the Makah and Quinalt Reservations, and to a lesser extent on the Hoh Reservation. The Bureau of Indian Affairs manages, as trustees for the Tribes, a substantial timber resource, under a sustained yield operating plan approved by the Tribal Councils. Revenues from sales of timber stands is an important component of the Makah and Quinalt tribal government income. Most of the employment generated by the forestry resource is in logging and transportation, since most of the timber harvested on the reservation is transported to mills outside of the reservation (Pacific Rim Planner, Inc., 1980).

Harbor development and maintenance activities occur on the Makah and Quileute Reservations. The Makah Tribe undertakes maintenance dredging of Neah Bay every 10 to 20 years. The Tribe is also planning harbor improvements and expansion to develop a commercial marina along the central portion of the south shore of Neah Bay. The marina would accommodate 300 boats and would be dredged to a minimum depth of 28 feet mean lower low water. The volume of dredge spoil generated by the proposed marine expansion is estimated to be approximately 154,000 cubic yards of sand. Dredge spoil will be utilized for beach nourishment projects with excess spoils utilized or disposed of on land (Simmons, 1993).

Additionally, the mouth of the Quillayute River is dredged to maintain the channel by the U. S. Army Corps of Engineers. Pursuant to the Quileute Coastal Zone Management Plan (Hyas' Ya' Kolla', 1981) dredging of the navigation channel shall occur only between January 1 and March 31 of any year. Dredge spoils are routinely deposited on the north jetty and breakwater of the Port of La Push. All dredging is timed, and measures are undertaken to protect fish habitat of the Quileute Reservation. The port facility is in need of significant repair and upgrading. The Tribe has received a small grant from the state to assist in strategic planning for port improvements including bulk fuel storage, waste oil containment, solid waste removal and public

rest rooms (Schaftlein, 1992).

Scattered areas on and off the Reservations are culturally significant to the Tribes. Property of cultural significance have an important role in the current community, but also may have historic significance to the Tribe's beliefs, customs and practices as well. These sites may be important if culturally significant events, activities or observances have occurred at the location, or if the user group designated a name to that particular place. These sites include ancient villages such as Ozette, burial grounds, ceremonial places for prayer, preparation and training, lookout places, etc... (Pascua, 1992). James Island and First Beach are particularly important to the Quileute Tribe as ancient burial grounds and areas of spiritual significance. The Hoh shoreline is a burial area for ancestors of the Hoh people. Destruction Island is also spiritually significant to the Hoh Tribe. In addition to areas set aside as culturally significant, the Makah Tribe has reserved over 1,000 acres of reservation land bordering the Pacific Coast as a wilderness area. The Quinault Tribe has set aside offshore rocks and islands as bird and wildlife sanctuaries. In addition, the estuarine habitats essential for salmon and wildlife are protected from development by policies set forth in the Quinault Coastal Zone Management Plan (Quinault Planning Commission, 1979).

Tourism holds future economic promise to the coastal tribes and is being strategically targeted as a way to alleviate the severe economic conditions prevailing on the reservations. The Quileute Tribe has a strong interest in tourism. La Push Ocean Park Resort provides a range of accommodations. Future efforts to accommodate tourism will emphasize providing food service, building additional tourist rental units, increasing winter tourism visitation rates, providing charter fishing services, and providing a museum/cultural center. During the tourist season, the tourist enterprises on the Quileute Reservation may bring the effective population of La Push to approximately 3,000 persons (Penn, 1992). The Makah Tribe is also targeting tourism, especially with their plans to expand and diversify the port of Neah Bay.

#### B. Sanctuary Study Area Resources

The study area of the Olympic Coast National Marine Sanctuary lies in the Oregonian biogeographic province (Figure 2, p. I-10) which extends from Cape Mendocino, California, north to Cape Flattery, Washington, including the Strait of Juan de Fuca. This province is characterized by a narrow continental shelf, mountainous shoreline and steep rocky headlands, interspersed with open sandy and pocket beaches, many small and few large rivers, and small estuaries with bay-mouth barriers. Waters in the Oregonian Province are cool and relatively clear with sea-

surface temperatures ranging between 9°-11° in winter and 13°-15° in summer. Ocean waters are dominated by the California Current. This province is characterized by having the greatest volume of upwelling in North America from February to September resulting from the interaction of ocean currents, winds and the submarine canyons that indent the shelf, most notably, the Juan de Fuca Canyon. These environmental factors combine to produce highly productive nutrient-rich waters and abundant marine resources along the outer coast and in the estuaries of Grays Harbor, Willapa Bay and the Columbia River.

The proposed marine sanctuary supports a multitude of species of algae, invertebrates, birds, marine mammals, and commercially important finfish and shellfish. Federally listed endangered or threatened species such as the bald eagle, peregrine falcon, brown pelican, Aleutian Canada goose, short-tailed albatross (although not listed as endangered within the United States), northern (Steller) sea lion, and gray, blue, and humpback whales inhabit this coastal area and the adjacent mainland. The rocky headlands along the coast north of Point Grenville provide important habitat for a wide variety of seabird populations, while the offshore islands and rocks of the Flattery Rocks, Quileute Needles, and Copalis National Wildlife Refuges are important as haulout areas for California sea lions and northern sea lions, and roosting and nesting habitat for seabirds. The western Strait of Juan de Fuca serves as an important migration corridor for bird and fish species moving to and from the San Juan Island archipelago and Puget Sound. Salmon, groundfish (e.g., halibut, rockfish, cod, sablefish, whiting), and shellfish (crabs, razor clams, oysters) are the mainstays of commercial and recreational fisheries in the sanctuary study area.

## 1. Environmental Conditions

### (a) Geology

The Pacific margin of the United States is the tectonically active edge of the North American crustal plate (composed mostly of continental crust) that has collided with and is overriding the sea floor of the Juan de Fuca oceanic crustal plate. The coastal margin is characterized by a narrow continental shelf, slope and rise, and is marked by earthquakes associated with geological faulting and volcanism (McGregor and Offield, 1986). The area of the proposed sanctuary is subjected to tectonic forces caused by the combined movements of the large Pacific and North America Plates and the smaller Juan de Fuca Plate (Figure 11). The altered sedimentary rocks of the Olympic Mountains and the volcanoes of the Cascade Range (Mount Saint Helens, for example) are the result of the convergence of these plates composed of oceanic and continental crusts.

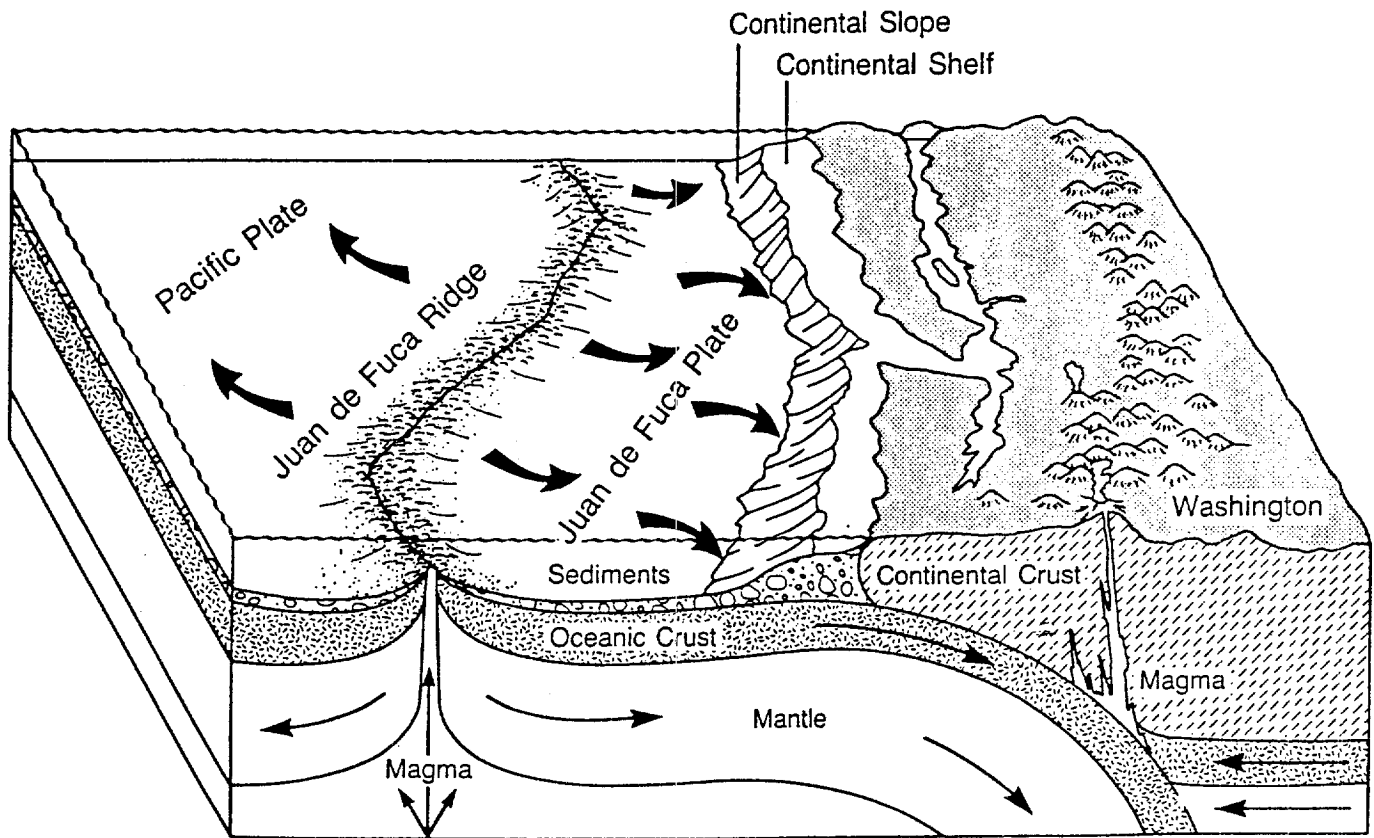


Figure 11. Plate Tectonic Structure of the Pacific Northwest Continental and Oceanic Region (Strickland and Chasan, 1989).

The continental shelf of the Washington coast is smooth and narrow, ranging in width from eight to forty miles (Washington State Dept. of Ecology, 1986). Submarine canyons incise the continental shelf and slope along the entire coast, and the heads of Juan de Fuca and Quinault Canyons are included within the proposed sanctuary (Figure 12). The continental slope consists of a steep and highly incised upper portion, and a more gently sloping lower portion which grades into the Cascadia Basin (Baker and Hickey, 1986). Although glacial deposits comprise the underlying relic sediments of the continental shelf, the Columbia River is the dominant source of modern sediments for the southern Washington Shelf (Nittrover, 1978 in Baker and Hickey, 1986). The northern shelf is fed by sediments carried from the Strait of Juan de Fuca. Year-round bottom currents and winter storms transport much of this sediment north-northwest. The sediment accumulates on the shelf as a band of sandy silt with the inner shelf sandy and the outer shelf comprised primarily of silt and clay (Carson, et al., 1986). Much of this sediment is transported to and deposited in the Quinault Canyon where it gradually works downhill into the Cascadia Basin (Cutshell, et al., 1986). Overlying the bedrock along many areas of the coast are deposits of sand and gravel laid down by glacial streams during extensive glaciation of the Olympic Mountains during the Pleistocene Epoch some 17,000 to 70,000 years ago (Rau, 1973). Prominent gravel pockets lie off Cape Flattery, Grays Harbor, and the mouth of the Quinault River (Moore and Luken, 1979).

The uplifted broad coastal plain that forms the coast of Washington extends from Cape Flattery southward and includes two tidal inlets, Willapa Bay and Grays Harbor (Weissenborn and Snively, 1968). Broad beaches, dunes, and ridges dominate the coastline from Cape Disappointment on the north side of the Columbia River mouth, to the Hoh River (Moore and Luken, 1979). The plain rises eastward and merges with the foothills of the Olympic Mountains. Wave action has eroded the plain through time and formed steep cliffs along the coast, except at river mouths. For most of the coast between Cape Flattery and Point Grenville these cliffs rise abruptly 50 to 300 feet above a wave-cut platform. This wave-cut platform, which normally extends about half a mile from shore, is nearly two miles wide west of Ozette Lake. Small islands, sea stacks, and rocks dot the platform's surface. Islands can be found in all stages of development from partially isolated promontories to true islands several acres in extent (op. cit.). The largest, Destruction Island, is 1.5 km long.

#### (b) Meteorology

The climate of western Washington is characterized by relatively mild winters and moderately dry cool summers. Most air masses reaching the coast originate over the Pacific Ocean and exert a moderating influence throughout the year. The

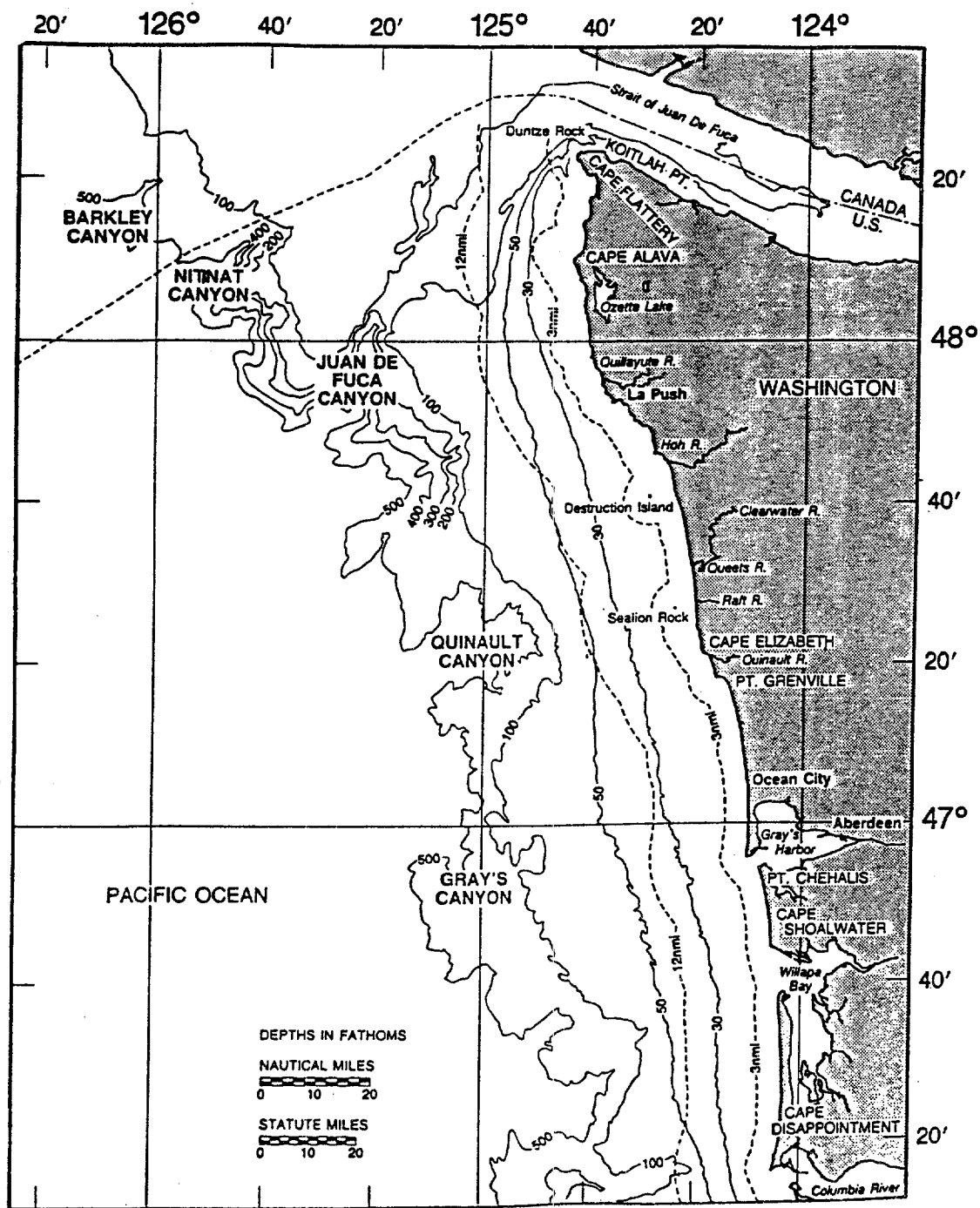


Figure 12. Bathymetry of the Olympic Coast Offshore Area and Submarine Canyons (Illustrations Unlimited, 1991).

climate is influenced by topography, location along the windward coast, prevailing westerly winds, and the position and intensity of high and low pressure centers over the North Pacific Ocean (Phillips and Donaldson, 1972).

In late spring and summer, westerly to northwesterly winds associated with the North Pacific high pressure system produce a dry season. In late fall and winter, southwesterly and westerly winds associated with the then dominant Aleutian low pressure system provide ample moisture and cloud cover for the wet season which begins in October. The rising and cooling of moist air along the windward slopes of the Willapa Hills and Olympic Mountains produces an area of heavy precipitation from the coast to the crests. Annual amounts range from 70 to 100 inches over the southern coastal plains and from 125 to 200 inches in the "rain forest" area on the western slope of the Olympic Mountains (op. cit.).

Afternoon temperatures near the coast during the summer are generally in the upper 60's (°F). In an average winter, maximum temperatures range from 38°F to 45°F and minimums from 28°F to 35 °F (op. cit.). The highest wind speeds recorded on the Washington coast reached 150 mph at North Head at the mouth of the Columbia River in January 1941, and 94 mph at Tatoosh Island in November 1942 (Oceanographic Institute of Washington, 1977, in Strickland and Chasan, 1989).

Ocean surface water temperature near the coast averages about 48°F in February, 52°F in May, 57°F in August, and 50°F in November. The range of seawater temperature is greater in shallow and protected bays along the coast. The temperature range offshore is slight throughout the year, thus inshore-offshore migrations of biota associated with seabed temperature changes (common in other coastal areas such as the mid-Atlantic) do not occur.

### (c) Waves and Currents

The Washington outer coast is known for its rough seas and large waves. Extremes of wave height ranging from 15m to 29m have been recorded on and beyond the continental shelf (Strickland and Chasan, 1989). The height and direction of waves vary seasonally. During summer, waves are lower in height, predominately from the northwest, causing longshore currents and sediment transport to the south. In winter, waves are generally higher and from the southwest, causing northerly longshore currents and sediment transport (Ballard, 1964 in Terich and Levenseller, 1986). U.S. Army Corps of Engineers (COE) hindcast data for a station off Grays Harbor show nearshore wave heights to average about 4m during November through January with maximum heights of almost 8m during October through December. Wave heights on the outer shelf average almost 5m during December

through January with a maximum of 11m in January (U.S. Army Corps of Engineers, 1988). The most severe wave conditions are caused by winter storms originating near Japan that move onto the U.S. Pacific coast. Storm winds ahead of warm fronts generate waves with significant wave heights up to 6-7m; winds associated with cold fronts generate waves of 8-10m significant height (Kachel and Smith, in press). Tsunamis, long-period sea waves produced by submarine earthquakes or volcanoes, occasionally strike the Washington coast. The Alaskan earthquake of 1964 produced a tsunami that reached a height of almost 4m at Seaview, Washington.

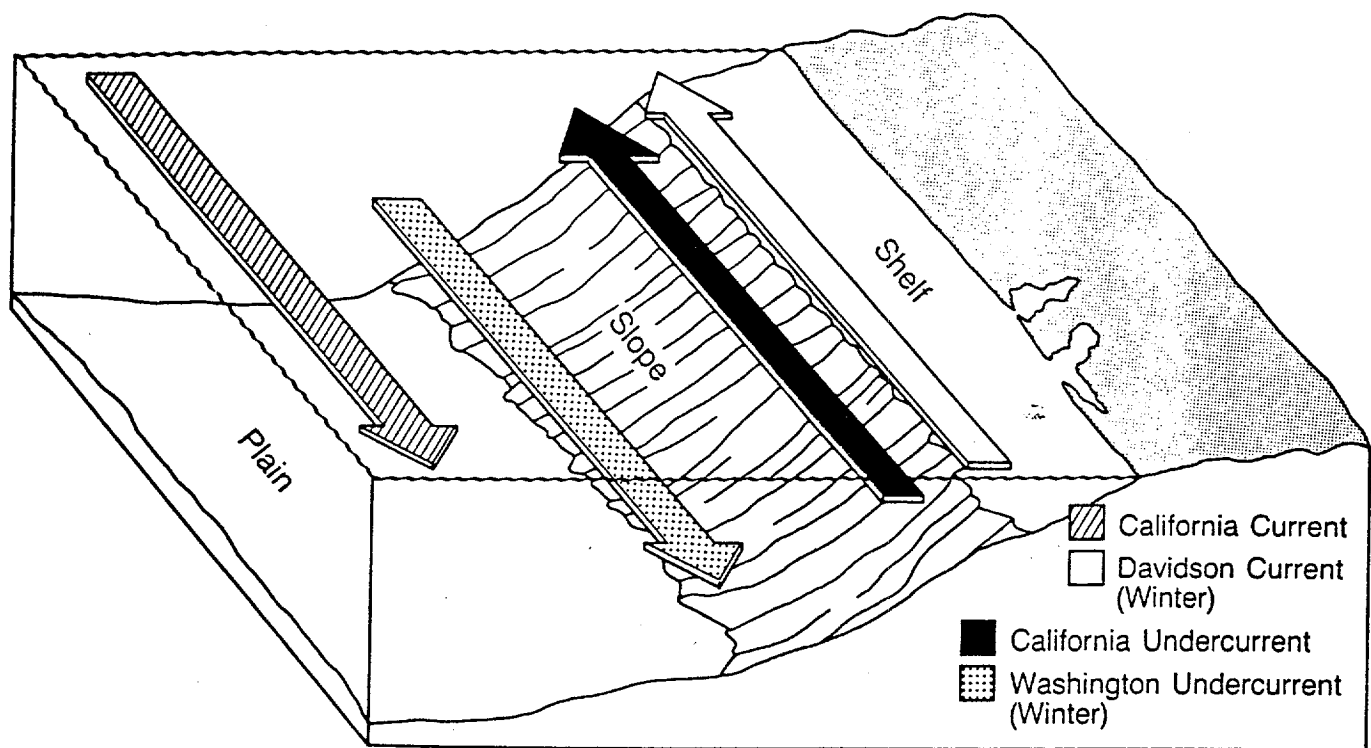
The oceanic current system off the coast of Washington is comprised of the California Current, Davidson Current, and California Undercurrent (Figure 13). The seasonal variation in the pattern of coastal circulation is the result of changes in direction of the dominant winds associated with large-scale atmospheric pressure cells over the Pacific Ocean.

The California Current flows southward beyond the continental shelf throughout the year. This current is approximately 1,000 km wide with a typical velocity of 10 cm/s. It brings low temperature, low salinity, high oxygen, and high phosphate subarctic water from high to low latitudes (Hickey, in press). The California Current is strongest in July and August in association with the dominant westerly to northwesterly winds.

The California Undercurrent, a narrow (20 km) subsurface countercurrent, flows northward along the upper continental slope with its core at a depth of about 200m. This current is also strongest in the summer with a mean velocity of about 10 cm/s. It brings warmer, more saline, low oxygen, low phosphate equatorial water from low to high latitudes (Hickey, 1979). A southward flowing bottom current (the Washington Undercurrent) flows deeper along the slope at about 400m depth during the winter.

During winter, the California current either moves offshore or is replaced by the near surface northward flowing Davidson Current. The Davidson Current flows over the slope and outer shelf during winter and early spring in association with the dominant southerly or southwesterly winds. It flows at a mean velocity of 20 cm/s and is associated with water masses with the same characteristics as the California Undercurrent.

Currents over the continental shelf tend to follow the seasonal pattern of the oceanic currents, but are also strongly influenced by local winds, bottom and shoreline configuration, and freshwater input (Strickland and Chasan, 1989) (Figure 14). General circulation over the shelf during winter is northward, driven by the southerly or southwesterly winds that predominate during that season. During the summer, northerly winds and



**Figure 13.** Oceanic and Continental Slope Surface Currents (Hicky, 1979).

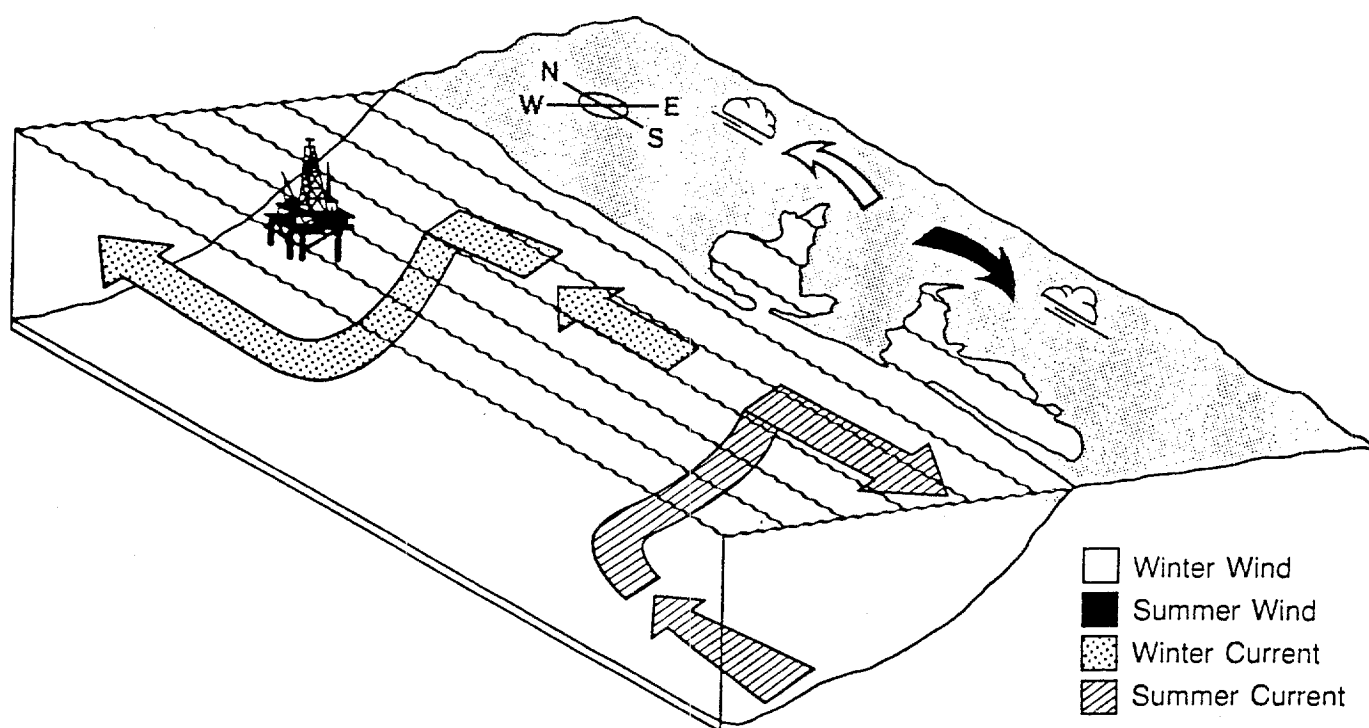


Figure 14. Simplified Mean Winter and Summer Current Patterns on the Washington Shelf. [ Mean Flow along the bottom is northward in all seasons. Mean surface flow is southward in summer, accompanied by Coastal Upwelling of Deeper Water. Mean Surface Flow is northward in Winter, accompanied by Coastal Downwelling of Surface Water ] (Strickland and Chasan, 1989).

associated upwelling produce a southward flow in the upper 100m. Current meter data (Hopkins, 1971; Hickey *et al.*, 1986, in Ridge and Carson, 1987) show that, on the average, near-bottom currents move northward and slightly offshore over the entire year.

Both the strength and direction of the currents over the shelf are highly variable. Maximum mean surface current speeds of 17 to 20 cm/s in a southerly direction have been observed at 20-30m depth in mid-shelf between April and June. Local currents in the surface layer may show complete reversals over the course of a few days due to passing weather systems, or fluctuations over weeks or months due to large-scale events such as temperature/salinity anomalies or El Niño.

As currents flow south along the coast during spring and summer, a combination of northwesterly winds and the earth's rotation causes the surface waters to be deflected offshore. As these waters are moved offshore they are replaced with cold, nutrient-rich waters from below. This process of upwelling introduces the nitrates, phosphates, and silicates that are essential for the high phytoplankton production that forms the basis for the oceanic food chain. The majority of this upwelling occurs within 10-20 km of the coast with the strongest offshore flow in the upper 10m of the water column. The submarine canyons that indent the Washington shelf are sites of enhanced upwelling (Parmenter and Bailey, 1985). Water upwelled from the Astoria and Quinault canyons moves across the shelf and is uplifted into the near-surface layers in the nearshore zone (Hickey, *in press*). Water upwelled in the Juan de Fuca canyon reaches close enough to the surface that it mixes into the surface layer and provides a direct source of nutrients over the canyon system (Freeland and Denman, 1982, in Hickey, *in press*). Upwelling occurs into the Strait of Juan de Fuca via the eastern head of the canyon. Downwelling, or sinking of surface waters, occurs along the coast during winter when southwest winds cause the onshore transport of surface waters. Downwelling produces intrusions of offshore surface water into the Strait of Juan de Fuca.

Tides on the Washington coast and Strait of Juan de Fuca are semidiurnal mixed tides with two high and low tides each tidal cycle characterized by inequalities in heights of successive high and/or low tides. Tidal currents on the shelf may reach 10 cm/s. Near shore, where tides are influenced by flow in and out of estuaries, tidal currents may exceed the mean wind-driven currents. Tidal ranges along the coast are large, averaging about 3.5m, ensuring a rich intertidal community. At Port San Juan (Port Renfrew) on Vancouver Island, for instance, the highest tides reach a level of about 3.5m above mean lower low water (Kozloff, 1983).

The Columbia River is the largest river on the U.S. west

coast and its large input of freshwater to the ocean affects the coastal waters of Washington and Oregon. A low-salinity surface plume is directed northward along the Washington coast by the prevailing currents in winter (Figure 15). The surface waters moving toward the coast hold the river discharge from the Columbia River near the shoreline and downwelling allows the water to migrate into the Strait of Juan de Fuca along the southern shore. Fresh water discharges from other rivers in the sanctuary study area are shown in Appendix C (Figure 2).

#### (d) Habitat Types

A marine ecosystem is a very complex and interconnected world with no hard lines of delineation between its various parts. Physical changes often occur gradually. Changes may include the shape and composition of the sea floor, depth, light intensity, salinity, temperature, biota, etc... Different combinations of these conditions form unique areas referred to as "habitats." Marine habitats are functional associations between places, water characteristics and living resources. The depth, surroundings, and species of a given area largely define the habitat for that area. A group of similar habitats forms an ecological "zone" and a unique combination of one or more zones forms an ecosystem.

A marine ecosystem has three broad regions that cut across zones and habitats. These regions are referred to here as "environments." The "littoral" environment is simply the tidelands or intertidal area. The "subtidal" environment is the sea floor from extreme low-tide to the edge of the continental shelf. The "neretic" environment is the water column over the continental shelf. These environments shape the form and function of all living marine resources.

The littoral and sublittoral environments (tidelands and floor of the continental shelf) are home to such invertebrate groups as polychaete worms, molluscs, arthropods, echinoderms, and crustaceans. In addition, these benthic environments harbor a wealth of marine plant life to include many varieties of kelp, surfgrass, and red, green, and brown algae. Marine vegetation is dependent upon quality and quantity of sunlight for growth and reproduction and is therefore confined to depths less than 55 fathoms (the euphotic zone). Therefore, non-planktonic species are most abundant in the nearshore thinning out as the sea floor progresses seaward to greater depth. Since the seaward limit of the preferred sanctuary boundary generally follows the 100 fathom isobath, all marine plant resources off the Olympic coast would be within the sanctuary boundary.

Organisms found in the neritic environment (the waters over the continental shelf) include phytoplankton, zooplankton, and most of the commercially important fish stocks (e.g., salmon,

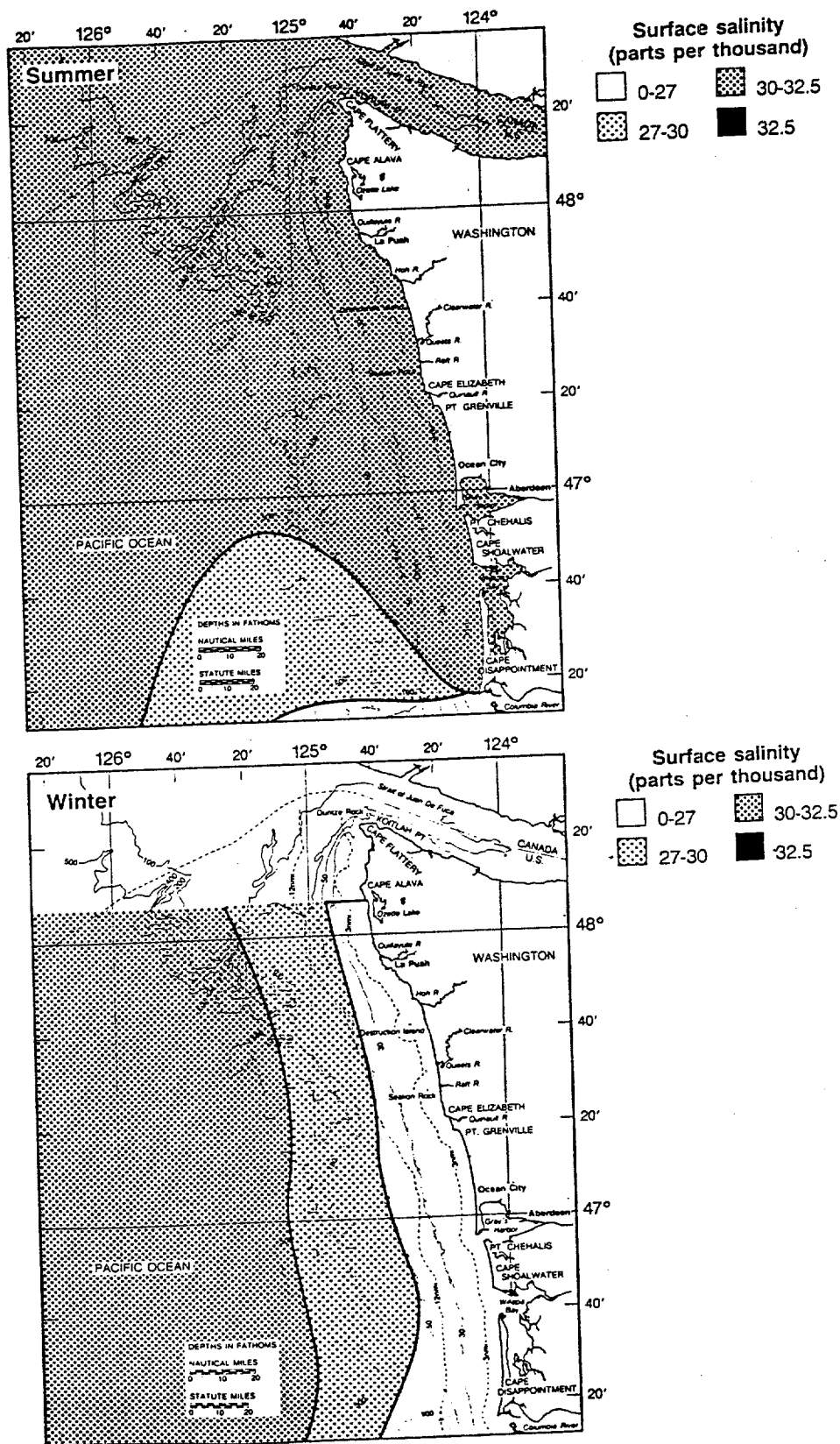


Figure 15. Generalized Position and Extent of Columbia River Freshwater Plume in Winter and Summer (Strickland and Chasan, 1989).

lingcod, sablefish, Pacific cod, and hake). Anadromous species are most present in the study area during outward juvenile migration and inland spawning migration. Marine birds such as shearwaters, alcids, storm-petrels, jaegers, and phalaropes feed throughout the study area. Marine mammals, including the northern and California sea lions, harbor seal, sea otter, California gray whale, harbor porpoise, and numerous other species of cetaceans are found in these coastal and offshore waters to varying degrees and at varying times.

As noted above, the littoral, subtidal and neretic environments weave through a series of bio-geographical zones. There are five such zones along the Washington coast: 1) the beach surf zone; 2) the rocky surf zone; 3) the above tide rocky shore zone; 4) the pelagic oceanic zone; and 5) the benthic oceanic zones. These zones run parallel to the shore and are defined by depth, bathymetry and sediment composition. Habitats within these zones are the basic marine communities discussed in this section.

The five zones and twelve associated habitats of the Washington coast extend seaward from the shore to the edge of the continental shelf. They range from turbulent rocky intertidal to deep and relatively placed sandy bottoms offshore. Each habitat is described separately in the pages that follow. Species lists for each habitat are arranged by trophic classification groupings in Appendix F. The pictorial descriptions and species lists are reprinted from a report prepared for the U.S. Fish and Wildlife Service (Procter, et al., 1980).

#### **i. Beach Surf Zone**

The beach surf zone is a dynamic environment with constantly shifting sands caused by wave action and longshore transport (Figure 16). The beach surf zone is characterized by two habitat types: 1) beach surf-unprotected; and 2) beach surf-protected. The sandy beaches of the northern outer coast of Washington are pocket beaches, nestled between resistant headlands. Beach surf habitats have much lower productivity and diversity than rocky habitats, but may be the sole support for certain species (eg. razor clam, Dungeness crab, and spawning surf smelt). Most organisms, such as polychaete worms, bivalve mollusks (including razor clam), isopods, and amphipods, burrow in the sand. Sand dollars, shrimps, purple olive snails, and Dungeness crabs live on the sandy bottom. Fishes found in this habitat include the staghorn sculpin, flounder, sand lance, and various species of sole and surfperch. Shorebirds and some terrestrial birds also forage in these areas.

##### **Beach Surf-Unprotected Habitat**

Unprotected beach habitat areas are interspersed along the

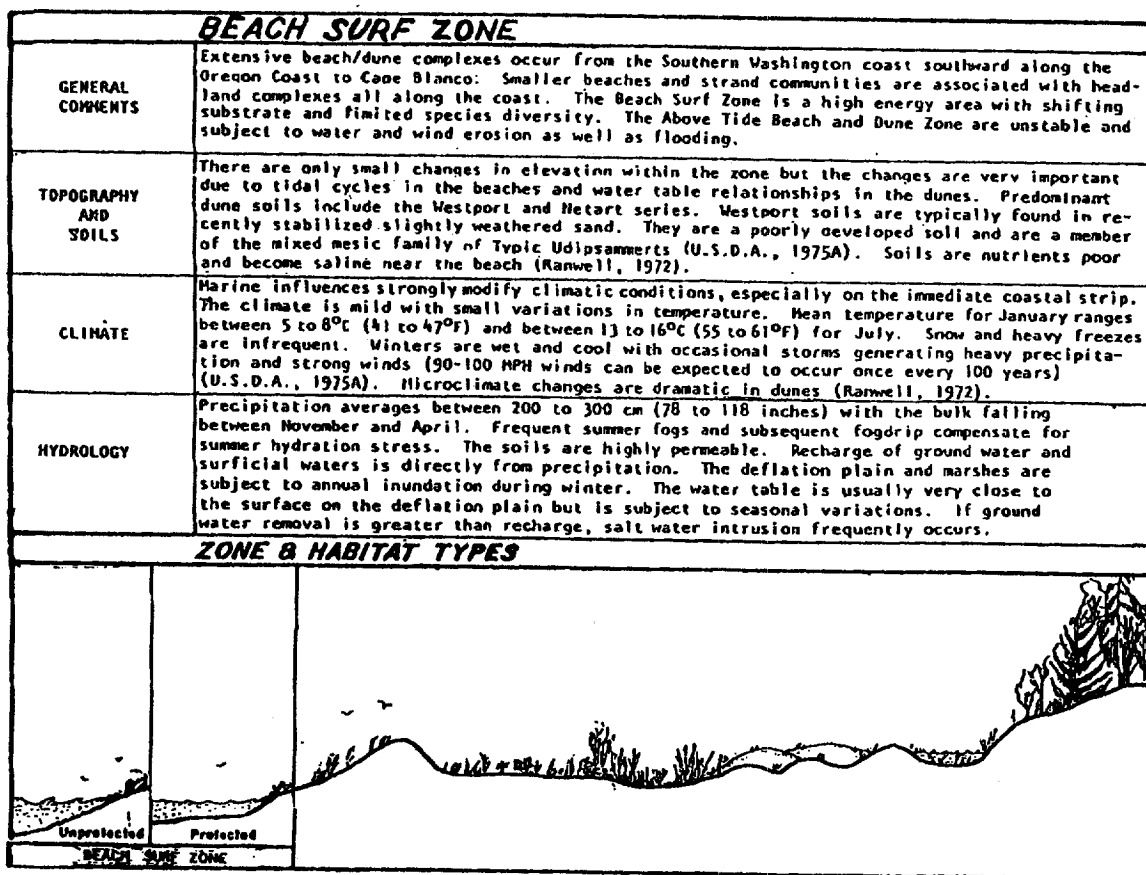


Figure 16. Beach Surf Zone Environment (Procter et. al, 1980).

Olympic coast as pocket beaches between rocky shores and headlands (Figure 17). This habitat becomes distinctly more prevalent south of Point Grenville. These beaches receive direct wave energy that sometimes "armors" the beach with gravel, cobbles or a mix of both. This armoring is often seasonal, affected by changes in tide levels, winds, currents and other oceanographic and atmospheric conditions. Changing conditions may also simply add or subtract sand, altering the slope and elevation of the beach. As the substrate sediments shift, flora and fauna must be able to endure the alterations or move to new areas to survive. Thus, species composition and dominance may fluctuate at different times of the year.

### **Beach Surf-Protected Habitat**

Protected beach habitats occur along the Olympic coast as pocket beaches between rocky shores and headlands (Figure 18). These areas are shielded from direct wave force by close proximity to headlands or protection behind offshore reefs, sea stacks, or islands. Protected beaches are more stable than unprotected beaches and are more likely to retain a consistent substrate composition. Less scouring from waves allows finer sediments (sand and organic matter) to settle on the seafloor.

Boulder and cobble fields are often found lying on sandy bottoms in the protected coves of the northern Olympic coast (e.g. Cape Alava and Cedar Creek). They support a much greater diversity of organisms than the sandy intertidal areas. These unique conditions support rocky-shore organisms found on large boulders, protected-shore organisms occurring in the lee of large rocks, and soft-sediment organisms living in the substrate beneath cobbles and boulders (Dethier, 1988). Algae and many invertebrates such as hardshell clams, crabs and other crustaceans, polychaete worms, and sea squirts are found in this habitat.

#### **ii. Rocky Surf Zone**

The rocky surf zone is found on rocky substrate between the lowest tidal level and the highest tidal level (Figure 19). Organisms living in this zone must be able to withstand periodic desiccation, high temperature and light, low salinities, and strong wave action (Nybakken, 1982). In the northeastern Pacific, intertidal zones of the most wave-beaten shores receive more energy from the breaking waves than from the sun (Leigh, et al., 1987). High wave energy enhances the productivity of intertidal organisms by providing space for habitation as species are eroded away, and by increasing the capacity of algae to acquire nutrients and use sunlight.

The rocky surf zone of the outer coast of the Olympic Peninsula includes some of the most complex and diverse shores in

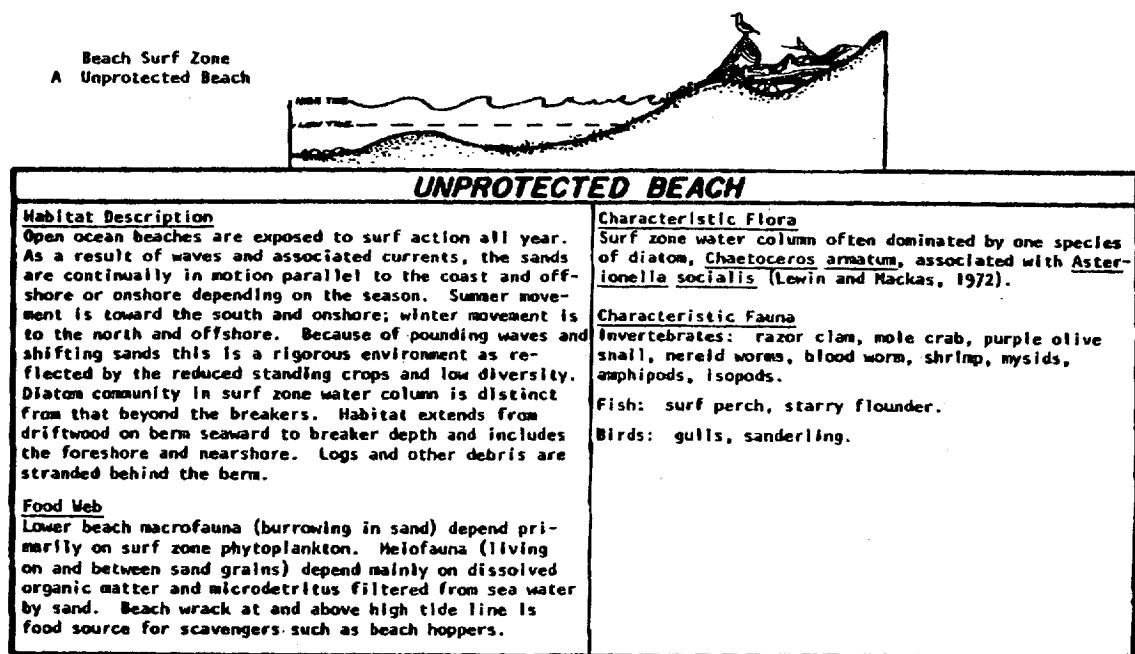


Figure 17. Beach Surf Zone Habitat-Unprotected (Procter et. al., 1980).

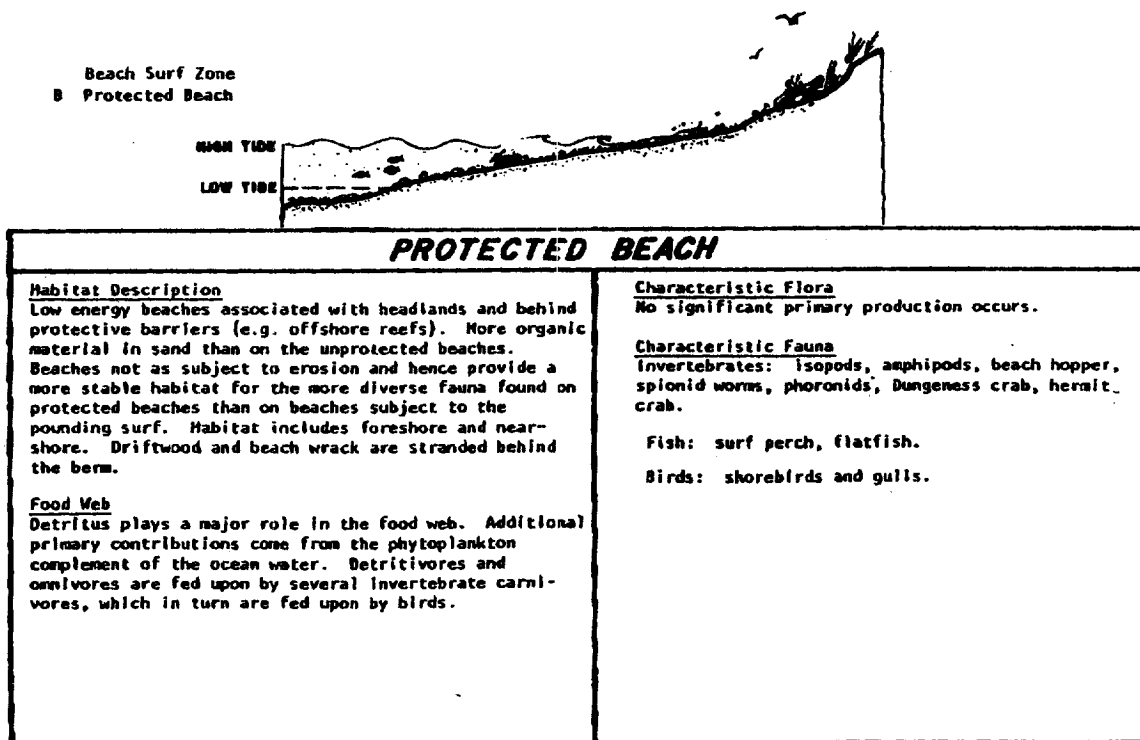


Figure 18. Beach Surf Zone Habitat-Protected (Procter et. al., 1980).

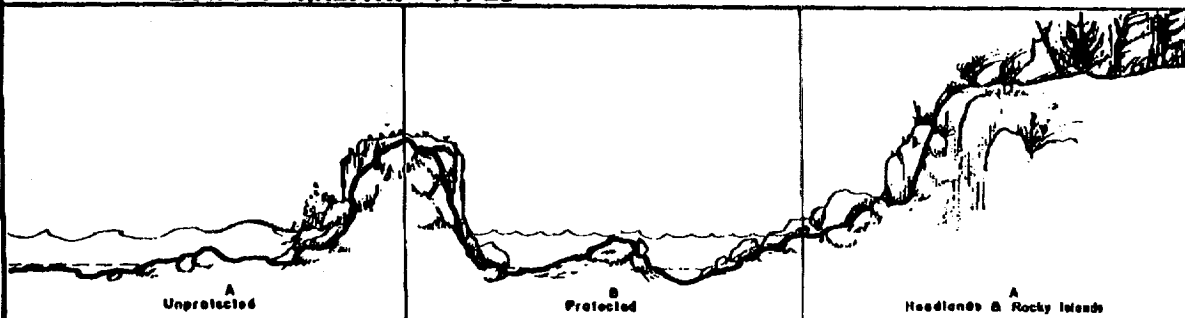
<b>HEADLANDS &amp; ROCKY ISLANDS</b>	
<b>GENERAL COMMENTS</b>	Headlands are marine/terrestrial ecotones typical of open rocky coasts. They are stressful, high energy environments. Coastal islands occur all along the coast except in the vicinity of the Columbia River mouth. Many support important sea bird colonies and hauling areas for marine mammals. Intertidal areas are subject to severe physical and chemical conditions. Some Oceanic habitats (e.g. Surfgrass) overlap with the Rocky Surf Zone.
<b>TOPOGRAPHY AND SOILS</b>	Headlands are typically steep and precipitous. Soils are generally local in origin and derived from basalt north of Cape Blanco and of sedimentary material south of the Cape. Cliffs can drop directly into the marine system to moderate depths. Slumping of cliffs is the sediment source for many local beaches.
<b>CLIMATE</b>	Climate is maritime with fluctuations of temperature and precipitation muted. Mean temperature ranges between 5° and 8°C (41 to 46°F) for January and between 14° and 16°C (57 to 61°F) for July. Snow and heavy freezes are atypical. Winters are wet and cool with occasional storms generating heavy precipitation, extreme tidal ranges, and strong winds. Strong winds frequently break off trees and carry salt spray inland which strongly influences the makeup of the habitat.
<b>HYDROLOGY</b>	The three major water inputs to the Above Tide area are winter precipitation, salt spray, and summer fog drip. Fresh water aquatic habitats are uncommon. Discharge is usually directly into the ocean. Waves are concentrated on headlands, and local currents can be severe.
<b>ZONE &amp; HABITAT TYPES</b>	
	

Figure 19. Rocky Surf Zone (Procter et. al., 1980).

the United States (Dethier, 1988). Dethier estimates that the rocky intertidal area of this section of coast contains at least 130 plant species (2 vascular plants, 5 or more lichens, and over 120 algae) and 180 animal species (mostly invertebrates) (Appendix C). Two habitats are present in this zone, distinguished from one another primarily by differences in wave energy.

Variation in the degree of exposure to environmental factors can create marked zonation patterns within rocky surf habitats (Foster, *et al.*, 1988). These visually distinctive bands of organisms are the result of wave action intensity at varying tide levels, tolerance of organisms to air and sunlight, and the presence or absence of predators (Steelquist, 1987). Within each rocky surf habitat are four vertical bands (or "zones"-this term should not to be confused with ecological zones): a splash zone, and upper, middle, and lower intertidal zones. The splash zone receives the spray from the surf during high tide and is covered with water only during storms. Algae, lichens, limpets, and periwinkles are residents here. The upper intertidal area is flooded during high tides. Barnacles, snails, mussels, seaweeds, and crabs frequent the rocks while shrimp, sculpin, and other fishes swim in the tidepools. The middle intertidal area is inundated more regularly and contains more biota than the higher zones. Predominant animals include mussels, sea stars, snails, worms, crabs, whelks, chitons, and rock scallops. The lower intertidal zone is exposed to the air only during the lowest tidal stages. It has a greater biological diversity than the other three zones. Typical organisms include starfish, anemones, octopi, sea urchins, sea cucumbers, and nudibranchs.

Sand-impacted rocky areas occur where rocky outcrops lie adjacent to or in the middle of high-energy sand beaches. Rocky surfaces that are scoured or periodically buried by sand require organisms living there to be tolerant of the burial and resistant to the scouring. Tolerant animals include the cloning anemone and several genera of chitons and tube worms.

#### **Rocky Surf-Unprotected Habitat**

Exposed rocky surf habitats vary from steep bedrock found on promontories and sea stacks, to flat benches dotted with tidepools (Figure 20). Only the most wave-tolerant organisms such as gooseneck barnacles and sea palms can survive on the steep bedrock. These areas receive full, direct wave force that produces a continuous erosional process. The sediment from this scouring action is sorted and deposited on nearby pocket beaches. Species in this environment are quite resilient and typically find protection within hard shells cemented to the rocks or by inhabiting available crevices.

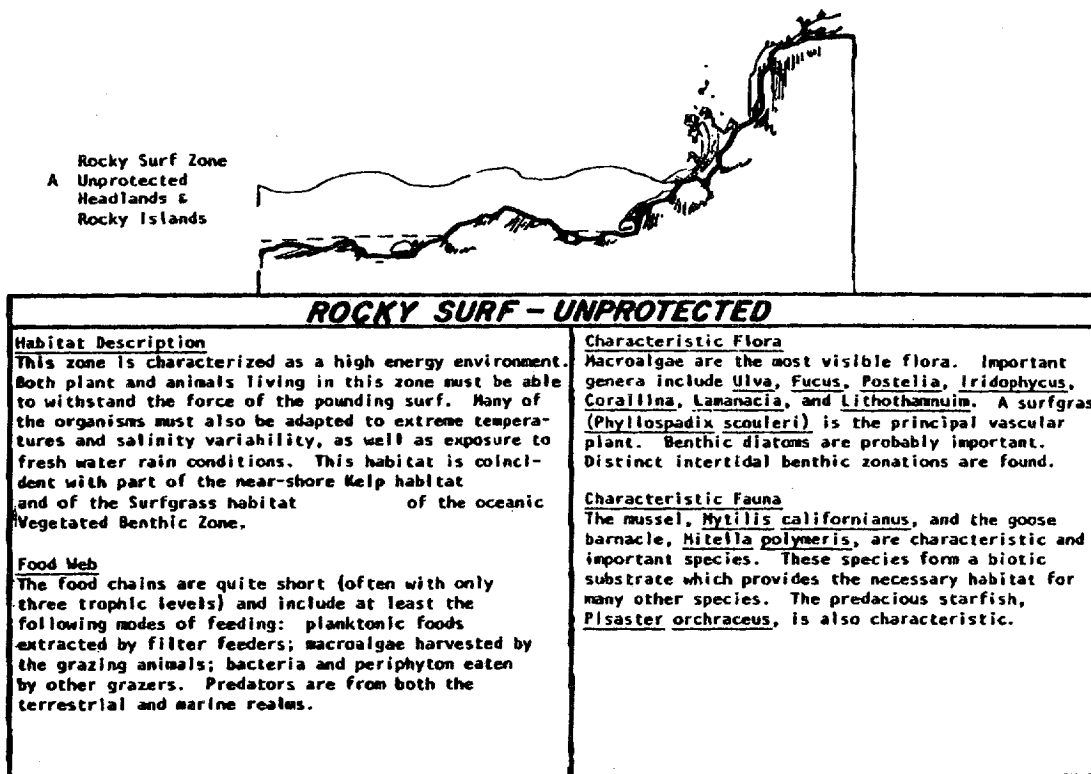


Figure 20. Rocky Surf Habitat-Unprotected (Procter et. al., 1980).

## **Rocky Surf-Protected Habitat**

The protected rocky surf habitat is a broad wave-cut terrace or an area where the force of waves is reduced by offshore rocks or sea stacks (Figure 21). Lower wave action and less spray enable different species of plants and animals to live here than on the exposed coast. Barnacles, turban snails, periwinkles, as well as surfgrasses are abundant in this more protected habitat.

### **iii. Above Tide Rocky Shore Zone**

Though this habitat is landward beyond the sanctuary boundary, it is extremely important to the nearshore ecosystem (Figure 22). It provides critical stationing and nesting areas for marine birds as well as pupping and haulout sites for marine mammals. Human modifications to this habitat can have drastic effects on the local ecology by altering sediment loading or creating conditions that allow predator access to previously isolated areas. Most headlands and rocky islands of the outer Olympic coast and western Strait of Juan de Fuca are protected within Federal, state, or tribal lands.

### **iv. The Pelagic Oceanic Zone**

The oceanic zones in the Sanctuary study area are divided into two major categories: 1) the pelagic zone - comprising the water column; and 2) the benthic zone - comprising the seafloor and waters one meter above (Proctor, et al., 1980) (Figure 23). The pelagic and benthic zones each have habitats that are characterized by the presence or absence of light. The pelagic zone can be divided into the euphotic and disphotic zones, and the benthic zone into vegetated and non-vegetated zones.

The euphotic and disphotic habitats together comprise the pelagic oceanic zone. These are the largest spatial habitats within the marine ecosystem, and they support plankton (sea drifters), and nekton (free swimmers). Seabirds thrive in the euphotic habitat, and many dive to impressive depths for food. Within the context of this report, the pelagic zone is synonymous with the neritic environment discussed at the beginning of this section.

### **Euphotic Pelagic Habitat**

The depth of the euphotic layer is determined by the distance that light penetrates the water column (Figure 24). This boundary is continually in flux and is affected by factors such as latitude, season, cloud cover, turbidity, sea state, and time of day. This is the layer of the ocean where phytoplanktonic production occurs and is a great feeding area for many species.

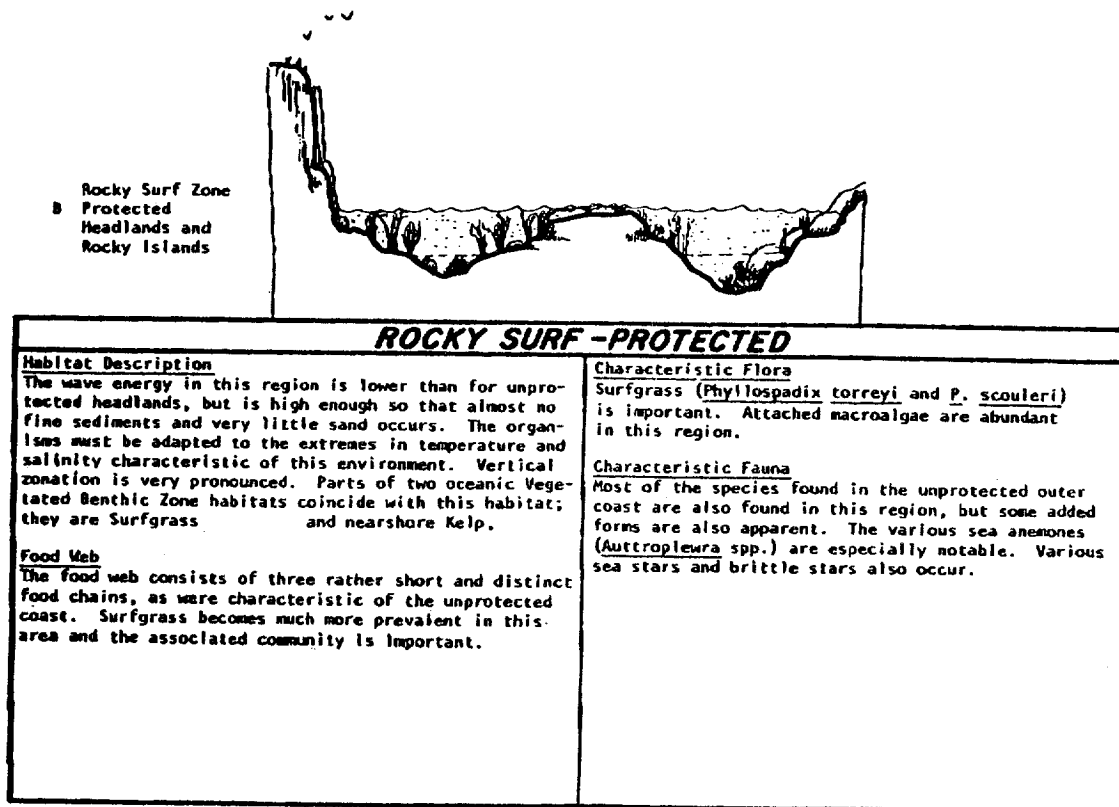


Figure 21. Rocky Surf Habitat-Protected (Procter et. al., 1980).

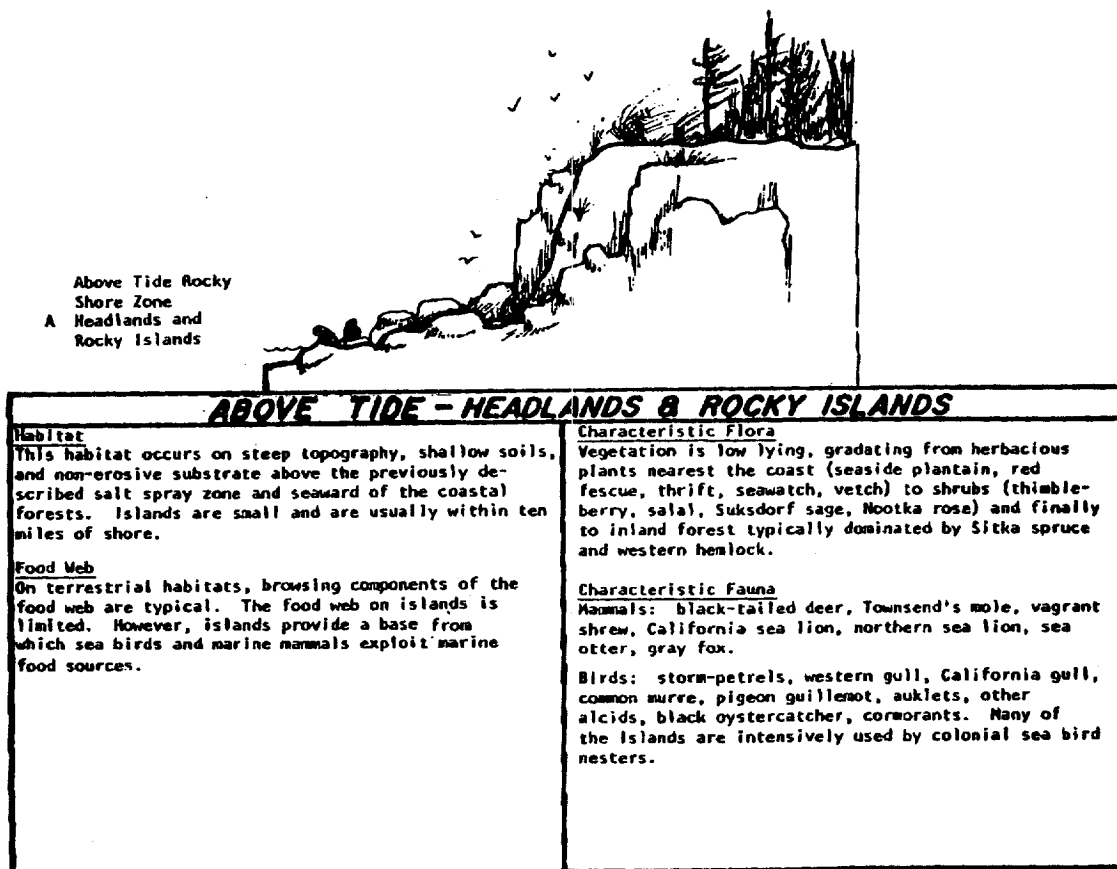


Figure 22. Above Tide Rocky Shore Zone (Procter et. al., 1980).

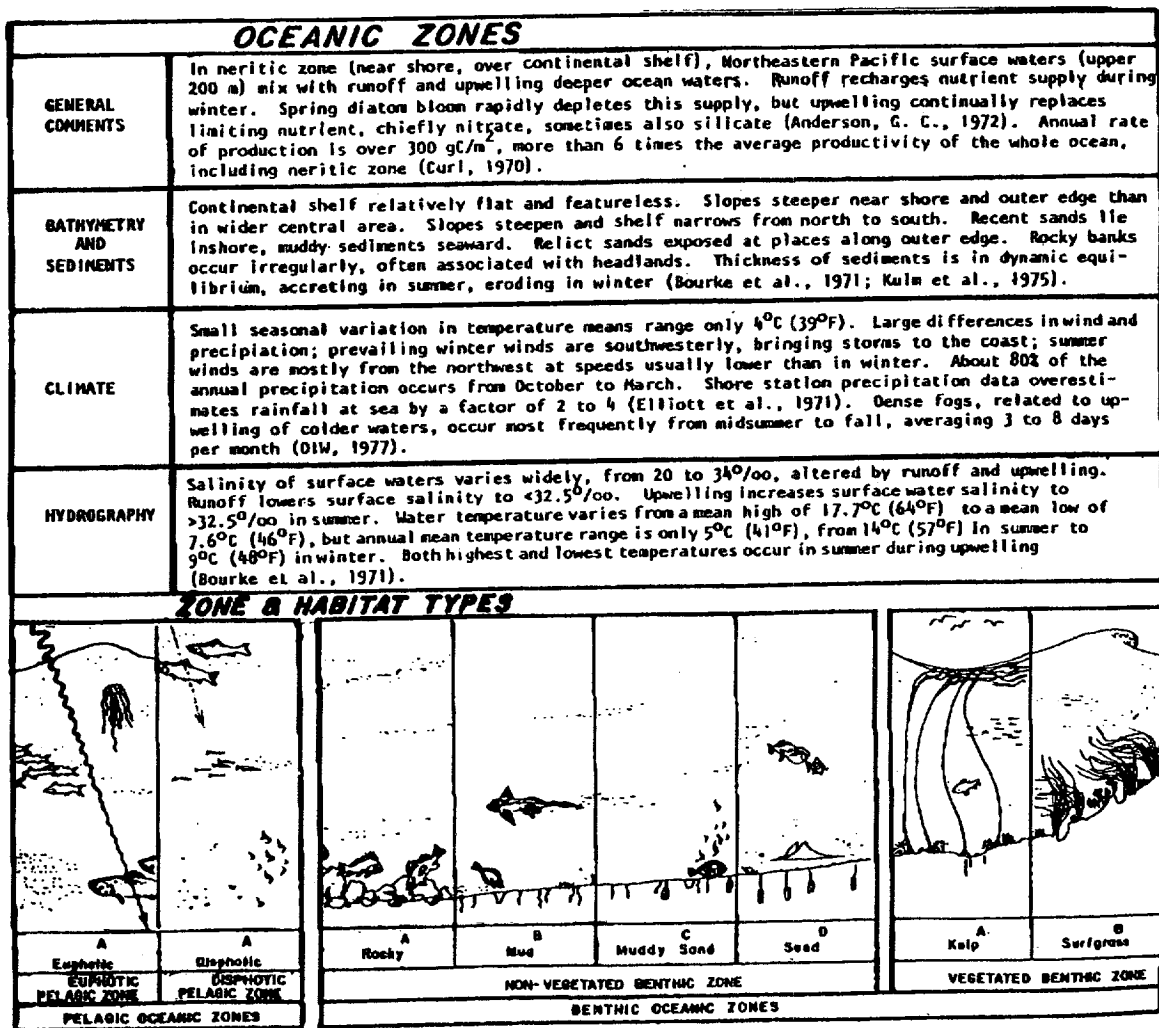


Figure 23. Pelagic Oceanic Zone (Procter et. al., 1980).

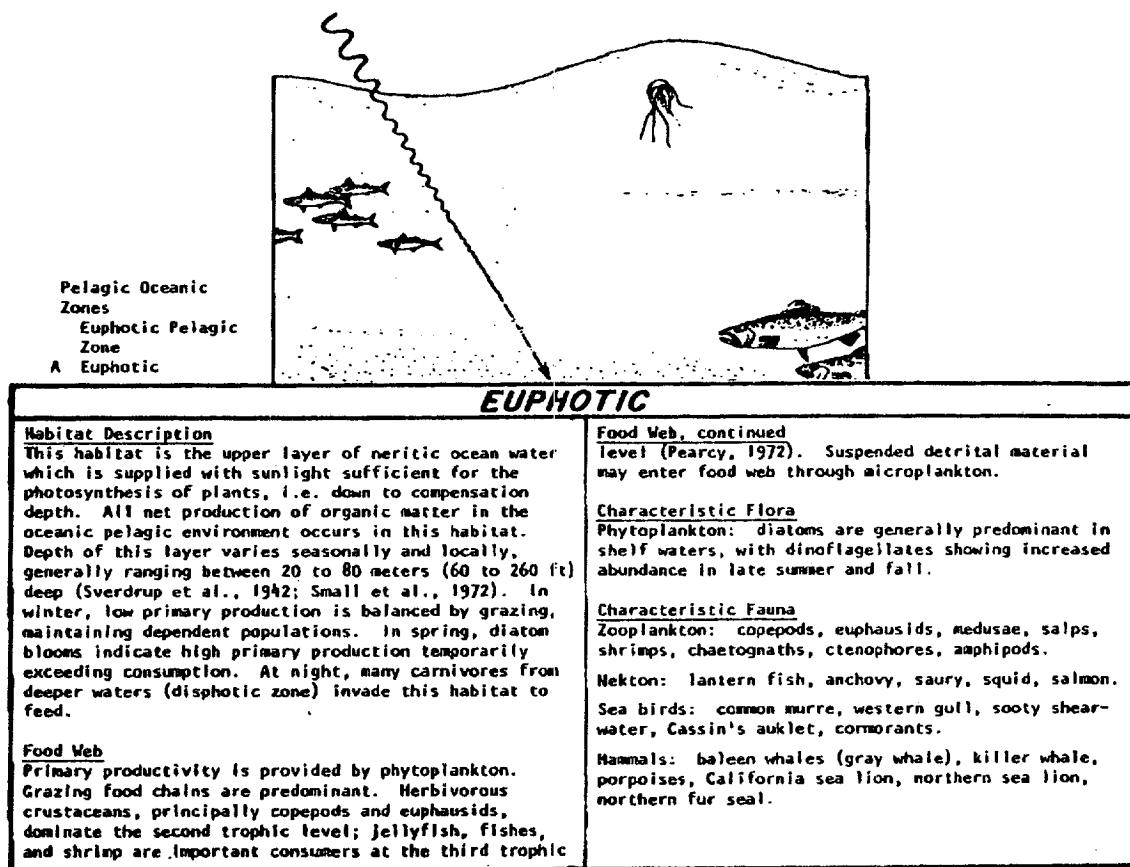


Figure 24. Euphotic Pelagic Habitat (Procter et. al., 1980).

## **Disphotic Pelagic Habitat**

Below the euphotic layer is the dark sphere known as the disphotic zone (Figure 25). The disphotic layer is the depth at which photosynthesis ceases in marine plants due to insufficient light energy. At night, the disphotic zone may extend from the sea floor to the sea surface to encompass the entire water column. As light penetrates through the water column, it is absorbed and scattered by water properties, particles and organisms (Duxbury and Duxbury, 1989). A twilight state exists at the boundary of the euphotic and disphotic zones. Blue and green wavelengths of light may penetrate into the disphotic zone but quickly fade to darkness. Zooplankton inhabit this habitat in large number during the day and migrate upward during the night to feed on the abundant phytoplankton in the upper layer.

### **v. Benthic Ocean Zone**

The benthic oceanic zone encompasses all submerged lands of the continental shelf. It is divided into two sub-zones distinguished by the presence or absence of light. The vegetated benthic zone coincides with rocky habitats and exists where light is sufficient for photosynthesis in attached marine plants. Two habitats (kelp forests and surfgrasses) exist in this zone. The non-vegetated benthic zone is completely devoid of plant life and is classified by changes in the sediments on the sea floor. Four different habitats are present in the non-vegetated benthic zone including the rocky, mud, muddy sand, and sand (Figures 26-29).

#### **Kelp Forests (Vegetated Benthic) Habitat**

Kelps are large brown algae (Order Laminariales) that attach to rocky substrates and grow to the surface in water depths from about 2m to 20m (Figure 30). The floating portions of these plants form dense canopies on the sea surface. Kelp forests form one of the world's most productive habitats. They provide critical habitat for encrusting animals such as sponges, bryozoans, and tunicates, as well as for juvenile fish, algae, abalone, and many other invertebrates. Fish associated with kelp beds include lingcod, kelp greenling, cabezon, various rockfishes and perch species, wolf eel, and red Irish lord. Kelp provides a food resource for fish, and for grazing and detritus-feeding invertebrates such as sea urchins and isopods. Sea otters depend on kelp beds for both food and shelter. Kelp beds also serve as resting areas for some birds such as gulls and herons. They also reduce wave action and currents shoreward of the beds, creating a sheltered environment for intertidal plants and animals, and reducing inshore erosion on beaches (WDOE, 1980b).

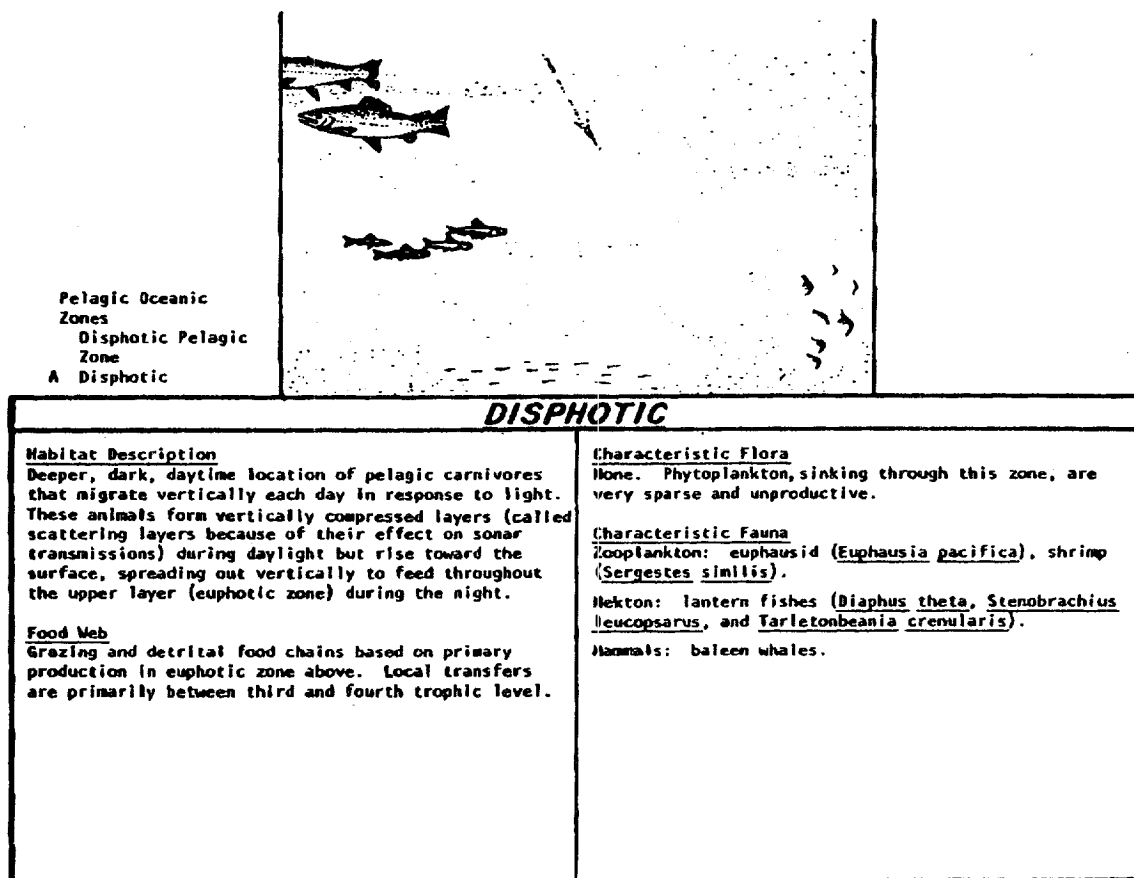


Figure 25. Disphotic Pelagic Habitat (Procter et. al., 1980).

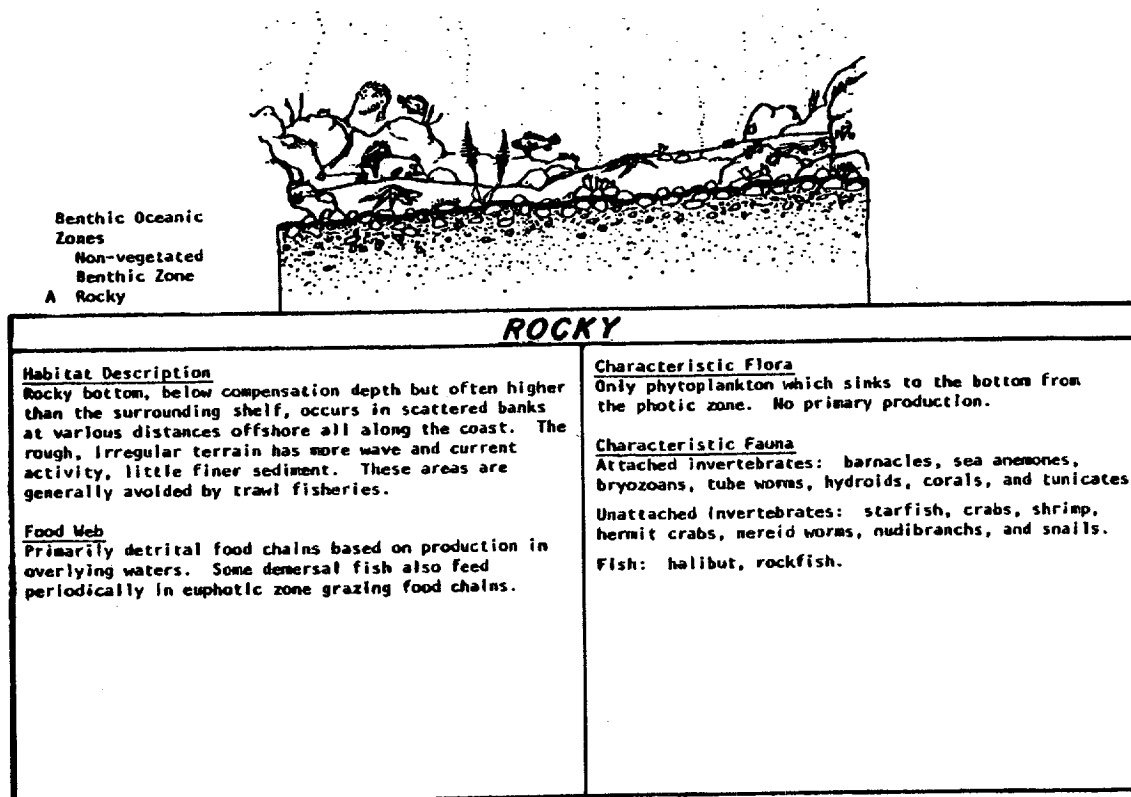


Figure 26. Rocky Non-Vegetated Benthic Habitat (Procter et. al., 1980).

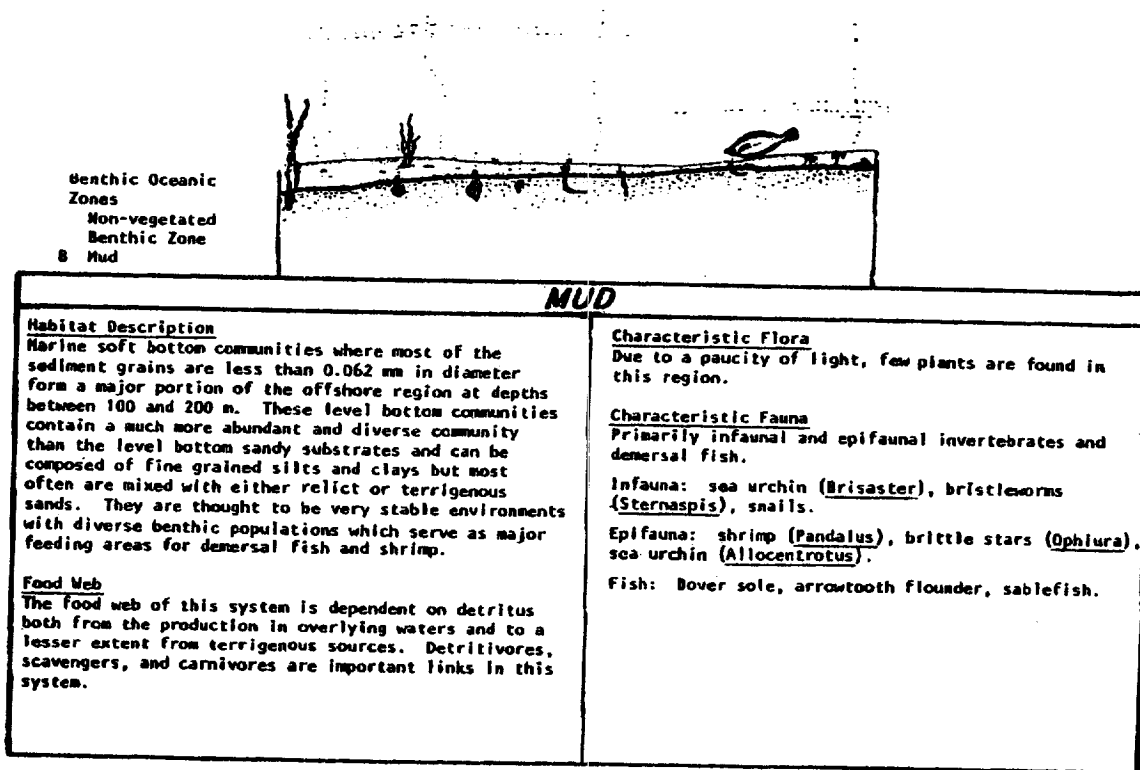


Figure 27. Mud Non-Vegetated Benthic Habitat (procter et. al., 1980).

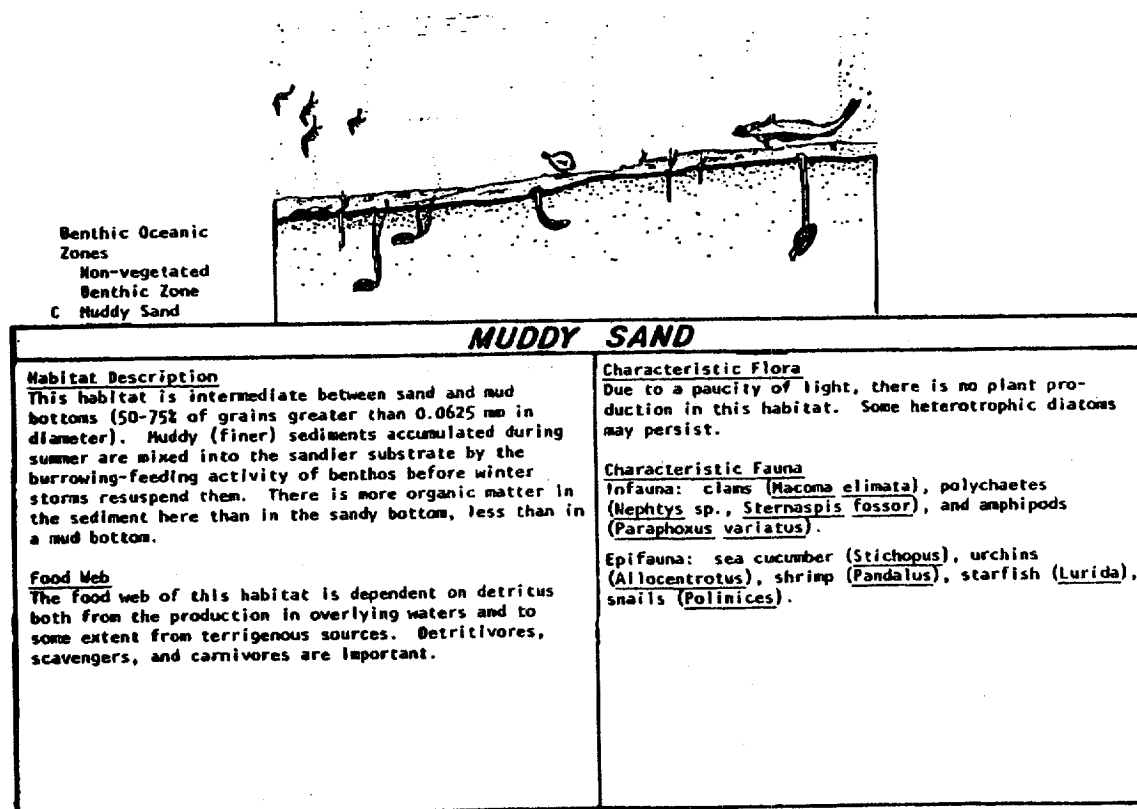


Figure 28. Muddy Sand Non-Vegetated Benthic Habitat (Procter et. al., 1980).

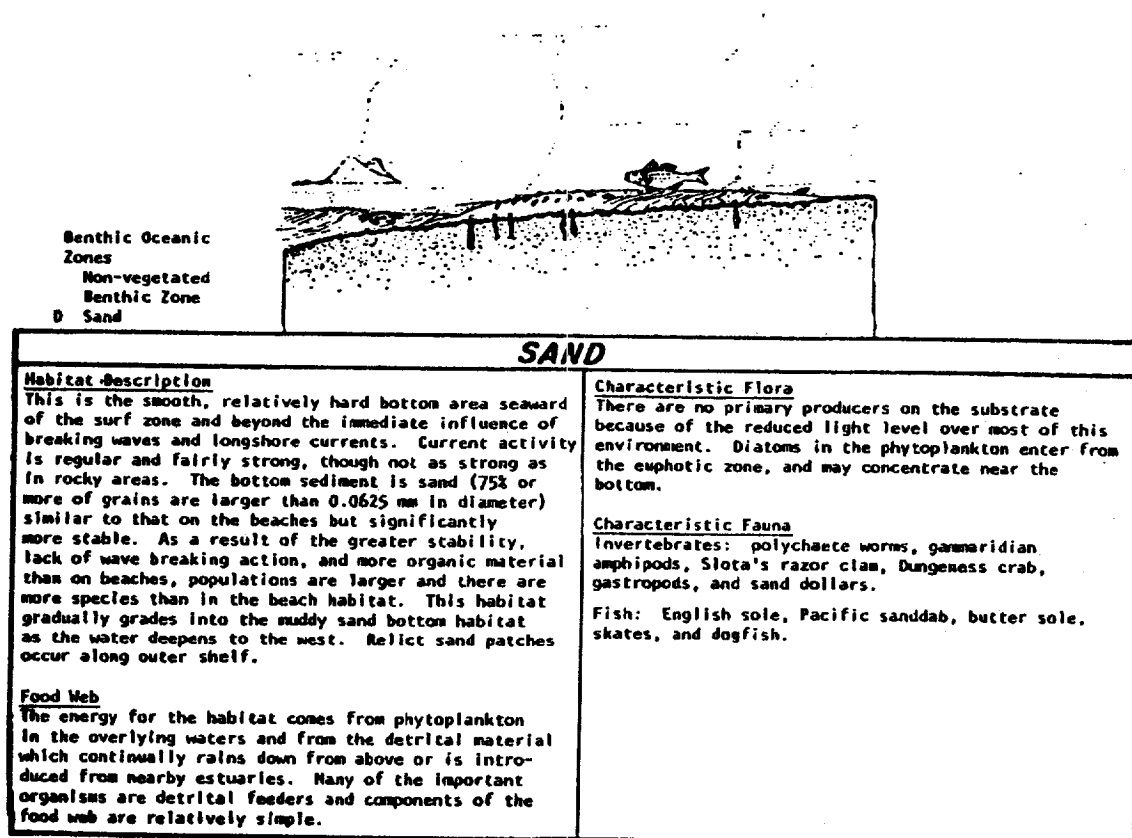


Figure 29. Sand (Non-Vegetated) Benthic Habitat (Procter et. al., 1980).

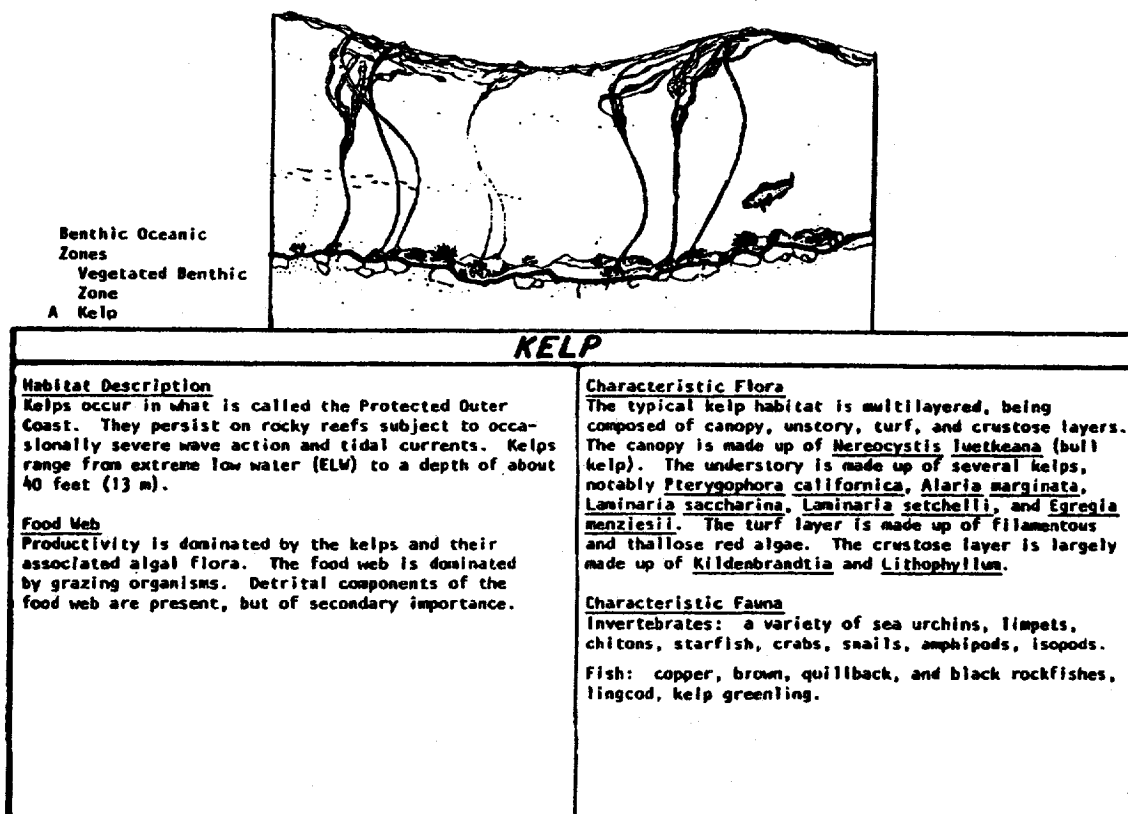


Figure 30. Kelp Habitat (Procter et. al., 1980).

## Surfgrasses (Vegetated Benthic) Habitat

A common surfgrass species, *phyllospadix scouleri*, ranges from Vancouver Island to southern California (Figure 31). It also appears on the exposed shores of the San Juan Islands. Though not a true grass, *phyllospadix* does produce flowers and is closely related to the grass family. Surfgrass does not root, but attaches to rocks by tenacious fibers. It offers cover and concealment for many organisms while releasing oxygen to nearshore waters. *Phyllospadix* can survive low-tide exposure in pools or channels with minimum water levels. It becomes a valuable haven to invertebrates and other intertidal species seeking shade from the sun during low tide (Kozloff, 1983).

### 2. Natural Resources

The natural resources of the Washington outer coast are the result of the environmental conditions previously described. The geology, winds and other meteorological factors, oceanic and nearshore currents, and diversity of habitats all contribute to the wealth of natural resources present. The living natural resources which will be protected by sanctuary designation include numerous species of plankton, algae, invertebrates, fishes, seabirds, and marine mammals.

For comparative purposes, the entire sanctuary study area was divided into seven subareas in the DEIS/MP to allow for the analysis of the distribution of living marine resources (Figure 32). An eighth region (subarea 1a) has been included in this FEIS/MP beyond the original seven due to evidence that the coastal ecosystem continues several miles into the Strait of Juan de Fuca. Coastal, geomorphological, oceanographic, and/or political features were used to delineate these subareas.

**\*Subarea 1** encompasses a relatively shallow offshore plateau known as "the plain", and the head of Juan de Fuca Canyon. The eastern boundary extends due north from Koitlah Point to the U.S./Canada international boundary. The northern edge follows the international boundary westward to the 100 fathom isobath. The western edge transects the head of Juan de Fuca Canyon and then generally follows the 100 fathom isobath. The surface area is approximately 753 nm<sup>2</sup> (2583 km<sup>2</sup>).

**\*Subarea 1a** includes an area within the Strait of Juan de Fuca that exhibits decidedly oceanic characteristics by its biological dynamics, oceanographic properties, bathymetry and coastal geology. This area was studied in a separate review to determine where oceanic properties of the outer coast cease to dominate the marine environment in the Strait. The area boundaries were established in accordance with the findings of the review. The analysis of the Strait of Juan de Fuca ecosystem can be found in Appendix E. The western boundary of subarea 1A

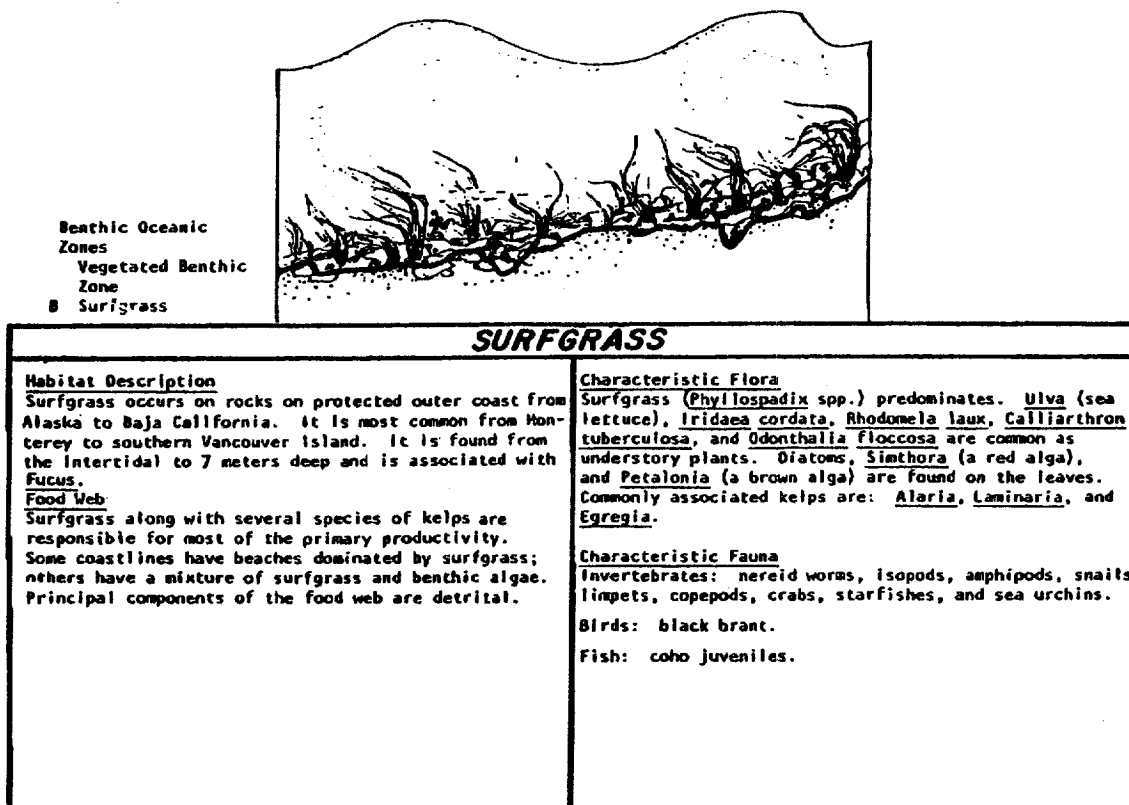


Figure 31. Surfgrass Benthic Zone (Procter et. al., 1980).

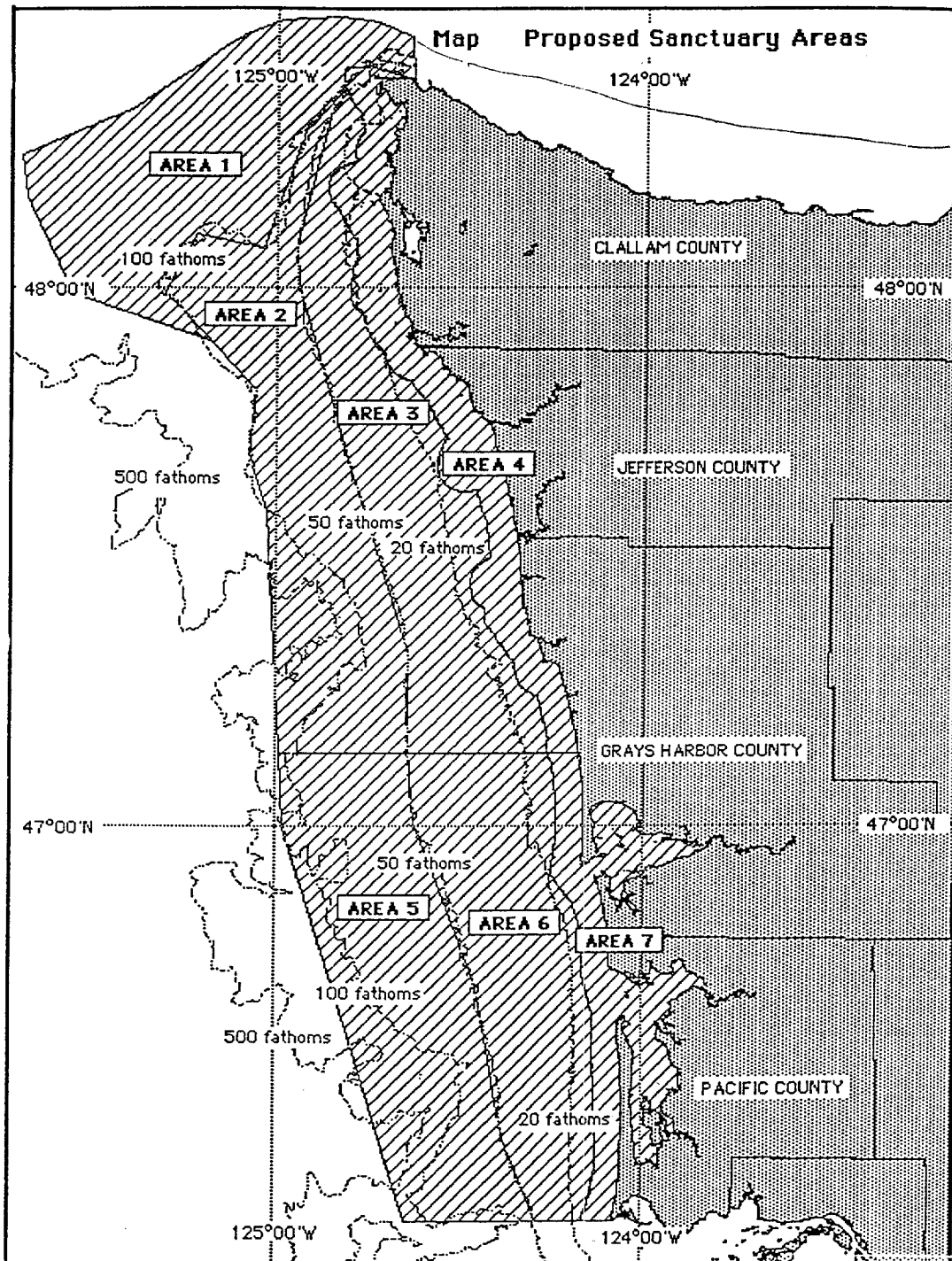


Figure 32. Sanctuary Study Subareas (SAB, 1990).

is contiguous with subarea 1 and extends due north from Koitlah Point to the U.S./Canada international boundary. The international boundary in the Strait serves as the northern edge of the subarea. The eastern boundary extends due north from Observatory Point to the international boundary. The surface area is approximately 255 nm<sup>2</sup> (873 km<sup>2</sup>).

**\*Subarea 2** lies above the outer edge of the continental shelf, is generally bounded east and west by the 50 fathom and 100 fathom isobaths respectively, and includes the head of the Quinault Canyon. The southern edge follows a line which extends due west from the southern tip of Copalis National Wildlife Refuge where coastal geomorphology changes from broad sandy beaches, to a rugged, rocky coastline with pocket beaches. The surface area is approximately 791 nm<sup>2</sup> (2712 km<sup>2</sup>).

**\*Subarea 3** represents the mid-shelf area, from the 50 fathom isobath in the west to the state's limit of jurisdiction (3nm) in the east. The southern edge follows a line which extends due west from the southern tip of Copalis National Wildlife Refuge where the coastal geomorphology changes from broad sandy beaches, to a rugged, rocky coastline with pocket beaches. The northern boundary encompasses the Juan de Fuca Canyon head to a point west of Cape Flattery. The surface area is approximately 669 nm<sup>2</sup> (2296 km<sup>2</sup>).

**\*Subarea 4** is equivalent to the sanctuary boundary proposed in the original SEL. It generally extends from the mean high water line to the seaward extent of the territorial sea (3 nm). The northern boundary arcs around Cape Flattery and terminates at Koitlah Point. The southern boundary is formed by an east/west line at the southern tip of the Copalis National Wildlife Refuge (NWR). The surface area is approximately 392 nm<sup>2</sup> (1346 km<sup>2</sup>).

**\*Subarea 5** represents the outer edge of the continental shelf between the 50 fathom and 100 fathom isobaths; and includes the head of Grays Canyon. The northern edge follows a line that extends due west from the southern tip of Copalis NWR. The southern boundary follows a line that extends due west from Cape Disappointment at the mouth of the Columbia River. The surface area is approximately 820 nm<sup>2</sup> (2813 km<sup>2</sup>).

**\*Subarea 6** represents the mid-shelf area, from the 50 fathom isobath to the state's limit of jurisdiction (3nm). The northern edge follows a line that extends due west from the southern tip of Copalis NWR. The southern boundary follows a line that extends due west from Cape Disappointment at the mouth of the Columbia River. The surface area is approximately 690 nm<sup>2</sup> (2366 km<sup>2</sup>).

**\*Subarea 7** extends seaward to the state limit of jurisdiction (3 nm). It includes the estuarine areas of Grays

Harbor and Willapa Bay. The northern edge follows a line that extends due west from the southern tip of Copalis NWR. The southern boundary follows a line that extends due west from Cape Disappointment at the mouth of the Columbia River. The surface area is approximately 286 nm<sup>2</sup> (981 km<sup>2</sup>).

NOAA's Strategic Assessment Branch (SAB) analyzed each subarea to determine its relative significance for selected species of invertebrates, fishes, marine birds, and marine mammals (subarea 1a was not included in this analysis). Individual species were assigned scores for each subarea based on their relative distribution and density. It was not necessary to assign special scoring points for endangered and threatened species since distribution of each species within the study area is scored relative to the entire population of that species for the EEZ of the contiguous U.S. west coast. Thus, a subarea may be significant to a species that is present only rarely, such as the sperm whale. One or two sightings of a species with a small population base would establish a high score.

The scores are presented in a series of tables (Appendix C, Tables 3 through 9) that allow the reader to compare subareas according to selected assemblages of marine fauna. While these tables do not provide an exhaustive list of species for each subarea, they do exemplify the general biological character of each region. The results of this analysis are used in developing and evaluating boundary options for the Sanctuary, as well as assessing the potential impacts of human activities occurring in the area.

#### (a) Plankton

Phytoplankton production on the Washington continental shelf is high. The upwelling of nutrient-rich waters into the surface layers, which is enhanced by the Juan de Fuca Canyon, supports the production of these microscopic plants which form the basis for the oceanic food chain. High productivity in the spring and summer coincides with the periods of coastal upwelling. The almost continual replenishment of nutrients (especially nitrogen) into the surface waters during the time of year when solar radiation is high, and days are long, is responsible for the continually high phytoplankton standing stocks and rates of production characteristic of this region (Perry, et al., in press).

Diatoms are the primary component of the phytoplankton. Dinoflagellates are also an important component and it is blooms of these single-celled plants that cause the outbreak of red tides in Washington. One of the dinoflagellates (Gonyaulax catenella) contains a powerful neurotoxin that causes paralytic shellfish poisoning and shellfish bed closures. While most surf-swept sandy beaches are areas of low phytoplankton occurrence,

the sand beaches of the southern portion of the outer coast have such a large persistent population of diatoms in the surf that the water is colored a conspicuous brown (Lewin, in press). The razor clam relies on the surf-zone dwelling diatom (Chaetoceros armatum) as its principal food source in area 4 and 7. The population of razor clams is so abundant that it accounts for over 70% of the recreational harvest of razor clams on the west coast (Schink, et.al., 1983; SAB, 1990).

Unlike phytoplankton, which are limited to the euphotic zone (approximately the upper 100m), zooplankton occur at all depths and can undertake daily vertical migrations of up to several hundred meters. A variety of zooplankton such as ciliates, copepods, euphausiids, and pelagic tunicates feed upon phytoplankton. In turn, zooplankton are an important food source for fish and other organisms, including whales. A large standing stock of zooplankton resides in an area from 5 nautical miles (10km) to 16 nautical miles (30km) off the coast (primarily within areas 3 and 6) during the summer. Copepods are the dominant group of zooplankton in terms of biomass (Landry and Lorenzen, in press). Euphausiids and copepods are the main food source for adult pelagic fishes. Most marine fish and shellfish species have planktonic eggs and larvae; these form an important part of the zooplankton at certain times of the year.

#### (b) Benthic Algae

Both microalgae and macroalgae are abundant and diverse on the outer coast. Over 120 species of algae have been identified in the rocky intertidal areas of the outer coast of the Olympic National Park (Dethier, 1988). Microalgae are primarily composed of benthic diatoms which are found as thin coatings on rocks or living within the sediment. These diatoms are an important part of the "algal film" forming diatom slicks on rocks and providing a principal food source for many grazing animals such as gastropods and chitons (McConnaughey, 1970). Marine lichens are found as thin veneers on rocks in the highest intertidal areas on exposed rocky areas.

Macroalgae are seaweeds that grow attached to a firm substrate from the intertidal region down to as deep as 40m, thus occurring primarily in areas 4 and 7. The seaweeds are composed of three main phyla: red algae (Rhodophyta), brown algae (Phaeophyta), and green algae (Chlorophyta). Kendrick and Moorhead (1987) present a summary of the algal species found, or expected to occur, at three intertidal sites along the coast of the Olympic National Park. The authors also discuss using two species of algae (Fucus distichus, and Endocladia muricata) as potential indicators of recreational impact on the intertidal communities of the National Park.

The red algae are the most diverse of the macroalgae in

terms of number of genera (about 115) and species (at least 265) in the Pacific Northwest (Waaland, 1977). In intertidal and shallow subtidal areas, red algae often occupy the understory of the larger kelps. Less common in the exposed areas of the outer coast, green algae inhabit the more protected marine and estuarine areas in Washington. These algae reside primarily in tidepools and rocky intertidal areas. Brown algae include the largest marine plants and are probably the most important macroalgal group in terms of primary productivity and direct economic value (Gardner, 1981). Brown algae vary from the large kelps to the less conspicuous forms that encrust rocks or form filaments on other algae. The Pacific Northwest coast supports the highest diversity of kelps in the world (Dayton, 1985). Two species of brown algae dominate the extensive kelp forests of the outer coast: the bull kelp (Nereocystis leutkeana) which is found in relatively protected waters; and the giant kelp (Macrocystis intergrifolia) which prefers more exposed areas (Steelquist, 1987). Macrocystis beds extend into the Strait of Juan de Fuca to Crescent Rock. Some of the most prolific macrocystis beds in the state are found in the Strait.

Algae play an important role in the functioning of the entire coastal ecosystem. Beside being a direct food source for animals, algae (especially kelps) produce large amounts of dead plant material (detritus) which is the basis for the detrital food web. Duggins et al. (1989) showed that growth rates of benthic suspension feeders are two to five times as high at kelp-dominated islands as at those without kelp beds. Algae provide important habitat for many animals and function as nursery and spawning areas for small fish. Sea otters and many species of fish closely associate with giant kelp forests.

### (c) Invertebrates

Many factors determine the distribution, species composition, and abundance of the invertebrate fauna. The seafloor geology, types of rocky substrate or unconsolidated sediments, offshore currents and circulation patterns, exposure to waves, water depth, Columbia River low salinity plume, and presence of mammal predators all influence the niches occupied by the various species. The upwelling off the coast brings cold, nutrient-rich water to the nearshore zone where it nourishes high marine plant productivity. This provides food and habitat for invertebrates that suspension feed or graze on algae (Dethier, 1988).

The rocky intertidal habitat supports the widest array of invertebrate species (Ricketts et al., 1985). Invertebrate species found during surveys along the coast of Olympic National Park are listed in Appendix G. Representative invertebrates include sponges, bivalves, isopods, amphipods, shrimp, barnacles, bryozoans, sea urchins, sea cucumbers, and sea stars.

Invertebrates residing in the boulder and cobble areas are diverse and consist of organisms living on and around the rocks and the soft sediment beneath them. Different species dominate in this habitat than in the rocky intertidal areas. Invertebrates living in the sediment under the rocks include the mud shrimp (Upogebia), mud dwelling brittle stars, and several species of clams and polychaete worms. Invertebrates living on or under boulders and cobbles include barnacles, limpets, amphipods, isopods, sea snails (Lacuna and Tegula), several species of crabs, the sea squirt Clavelina, and various species of edible clams (butter clams, littleneck clams, and horse clams).

Invertebrates found in sandy intertidal areas are less diverse than in other habitats, but some species may be found in large numbers. For example, Dethier (1988) discovered great quantities of amphipod crustaceans and polychaete and nemertean worms at several sites on the outer coast. The amphipod Euhaustorius was found in densities up to 10,670 individuals/m<sup>2</sup>. Densities of the bloodworm Euzonus reached almost 7,000/m<sup>2</sup>. Other invertebrates present include razor clams (Siliqua), isopods, mysids (opossum shrimp), sand dollars, purple olive snails, several species of clam (eg. Macoma secta and Tellina bodegensis), and Dungeness and mole crabs.

Invertebrates associated with kelp beds include many encrusting varieties such as sponges, bryozoans, and tunicates. Other invertebrates include amphipods, copepods, euphausiids, numerous species of crabs, sea urchins, shrimps, sea stars, brittle stars, periwinkles, limpets, sea snails, sea slugs, scallops, and abalone.

Squid, octopi, jellyfish, salps, heteropods, shrimp, and euphausiids are some of the macro-invertebrates found in the pelagic environment. Numerous larval invertebrates are also found there during their planktonic stages of development.

Thus, both the coastal and offshore areas are important to invertebrates depending on whether the invertebrates are sedentary or pelagic. The significance of selected invertebrate species to each of the 7 areas within the study area is shown in Appendix C (Tables 3 and 4). Two observations are apparent: areas 4 and 7 stand out as the most significant of all seven zones; and four invertebrates are particularly significant within the study area: 1) Pacific oyster, 2) ocean pink shrimp, 3) Dungeness crab, and 4) razor clam. Pacific oyster, Dungeness crab, and ocean pink shrimp landings from the areas under consideration for sanctuary status had combined landed values in 1987-88 of over \$25 million (about 85% of the statewide totals for harvests off Washington) (WDF, 1987; NMFS, 1989). Decimation of razor clam populations due to pathogen infestations and other natural calamities in the early 1980's has ended

commercial harvests, but recreational digging on Washington's outer coast currently accounts for over 70% of the contiguous U.S. coastal sport harvest.

Area 7 is particularly important for Pacific oysters because of the significance of Grays Harbor and especially Willapa Bay to oyster production (Appendix C, Figure 14). These two estuaries account for over half of all oysters harvested along the entire U.S. West Coast, and sometimes represent nearly 1/5 of the nationwide harvests (NMFS, 1989a). Areas 4 and 7, and the shallower portions of areas 3 and 6 (within 40 fathoms), are locations where more than 75% of the state's Dungeness crab catch is taken. Additionally, areas 4 and 7 are important for juveniles of the Dungeness Crab. The areal distribution of the ocean pink shrimp in the Washington outer coast occurs primarily in areas 2 and 5.

#### (d) Fish Resources

The diverse and abundant fish fauna along the outer coast are significant commercial and recreational resources. The same environmental factors that determine distribution, abundance, and species composition of other living resources of the area also affect fish communities. The diverse habitats of Washington's outer coast each claim their own characteristic assemblage of fish.

Fish of the nearshore sublittoral habitat show the greatest diversity and include many commercially important species. Salmon are anadromous fish that spend most of their life in salt water but return to fresh water to spawn at maturity. Five species of Pacific salmon occur along the outer coast of Washington: chinook, sockeye, pink, chum, and coho. Two other salmon-related anadromous species, sea-run cutthroat trout and steelhead, also inhabit offshore waters. Other species include albacore tuna, Pacific halibut, flounder (starry and arrowtooth), sole (petrale, Dover, English), numerous species of rockfish, Pacific cod, Pacific hake, lingcod, sablefish, thresher shark, Pacific herring, northern anchovy, jack mackerel, pollock, spiny dogfish, green and white sturgeon.

Fishes associated with sandy intertidal areas include starry flounder, staghorn sculpin, sand lance, sand sole, redbelt surfperch, and sanddab. Surf smelt spawn at high tide on sandy beaches where surf action covers and aerates the eggs (Gardner, 1981).

Many of the finfish found in shallow rocky reefs are also common in kelp beds. The kelp canopy, stipes, and holdfasts increase the available habitat for pelagic and demersal species, and offer protection to juvenile fish. The numerous species of rockfish are the dominant fish. Other associated species include

lingcod, kelp greenling, cabezon, kelp perch, wolf eel, and red Irish lord.

The rocky intertidal habitat is characterized by a rather small and specialized group of fish adapted for life in tidepools and wash areas. These fishes include tidepool sculpin, wolf eel, juvenile lingcod and greenling, gunnels, eelpouts, pricklebacks, cockcombs, and warbonnets.

The significance of the subareas to the distribution of several selected fish species found in the study area is summarized in Appendix C (Tables 5 and 6). Two observations are noteworthy. First, the salmon and groundfish species assemblages are the most significant species in the study area. The region is not only important for those salmon that spawn in streams adjacent to the study area, but potentially encompasses the migration corridor of both juvenile and adult salmonids from California, Oregon, and British Columbia as well. Second, the analyses suggest that offshore and mid-shelf areas under consideration for sanctuary status (areas 1,2,3,5, and 6) generally are more significant for non-anadromous fishes than the inshore areas.

Offshore areas 1 and 5 are the most important areas for commercial harvests of groundfish. More than 2/3 of annual 1987-88 outer coast harvests came from these areas for the following species: Pacific ocean perch, lingcod, English sole, Dover sole, Pacific cod, and sablefish. Area 5, produced the majority of harvests of widow rockfish. It is important to note, however, that four of the top ten fishes commercially harvested along the outer coast of Washington (chinook, coho, and chum salmon, and lingcod) are either estuarine-associated (i.e., they use estuaries during some time in their lives) or estuarine-dependent (i.e., they require estuaries to complete their life cycles). Additionally, the top four recreational species for Washington (chinook and coho salmon, steelhead, and lingcod) all utilize estuaries, at least as juveniles.

#### (e) Marine Birds

The rocky headlands, islands, and highly productive waters of the Washington outer coast provide essential habitat for a wide variety of both migratory and resident marine birds. Beyond their common link to the sea, marine birds are a very diverse group. They differ by size, shape, feeding habits, spatial distribution, habitat requirements, sensitivities and a host of other characteristics. The complex nature of many species makes it difficult to group birds into neat categories and impossible to apply sweeping characterizations about marine bird behavior. There is nearly always an exception to every rule, even among birds of the same species.

Bird surveys can thus be quite tedious and results may vary according to the degree of difficulty in gathering information and the resources available to researchers. For example, gathering production statistics on colonial nesters that lay their eggs on exposed, rocky surfaces (e.g. Common murre) is much easier and more precise than collecting the same data on species that scatter into coastal forests to nest in both old growth trees and concealed burrows (e.g. Marbled murrelet). Due to such differences, knowledge about some species is far more complete than for others.

Nevertheless, information on marine birds of the Washington coast has advanced dramatically over the past decade. The most comprehensive reports have been commissioned by state and Federal resource management agencies. This discussion draws heavily on those reports - particularly those by Strickland and Chasan, 1989; Speich & Wahl, 1989; Wahl, 1984; SAB, 1990; and MMS Study, 1992. These reports were produced through extensive literature searches and the most current survey techniques. They represent the best available information on Washington marine bird populations. Therefore, portions of these texts have been directly incorporated into this report. It should be noted that the 1992 MMS Study (cited above) was the first attempt to-date to describe offshore avifaunal distribution off Oregon and Washington using repeated, systematic sampling. Coastal nearshore populations have been tracked closely for two decades by Terence Wahl, Ulrich Wilson, and other researchers.

Data compiled from various sources lists approximately 128 marine bird species present off the Washington coast. Speich et al. (1987) reported a total of 87 species of birds observed or known to occur in the area between Point Grenville and Sealion Rock (Table 1). An additional 41 species known to occur in the study area and are listed in Table 2. At least eleven of these additional species occur regularly in the offshore waters along the coast, some in large numbers: black-footed and Laysan albatrosses, pink-footed, flesh-footed, Buller's and short-tailed shearwaters, red phalarope, south polar skua, Sabine's and glaucous gulls and Xantus' murrelet (Wahl, 1991).

Species composition and abundance of marine birds vary by season in Washington coastal waters. While many species of birds are year-round residents, others may be summer or winter visitors, or migrants passing through on spring and/or fall migrations.

Resident birds are present throughout the year. Breeding residents nest in the coastal areas of Washington. Non-breeding residents are represented by non-breeding individuals (juveniles that do not migrate) during the spring and summer periods. The glaucous-winged gull is a resident species that nests in coastal Washington, and many individual birds live their entire life in

Table 1. Bird Species Observed in Sealion Rock Study Area.  
Source: Speich et. al., 1987.

Common Name	Genus/Species	Common Name	Genus/Species
<b>Loons</b>		<b>Oystercatchers</b>	
Red-throated loon	<i>Gavia stellata</i>	American black oystercatcher	<i>Haematopus bachmani</i>
Pacific loon	<i>Gavia pacifica</i>		
Common loon	<i>Gavia immer</i>		
<b>Grebes</b>		<b>Shorebirds</b>	
Horned grebe	<i>Podiceps auritus</i>	Wandering tattler	<i>Heteroscelus incanus</i>
Red-necked grebe	<i>Podiceps grisegena</i>	Spotted sandpiper	<i>Actitis macularia</i>
Western grebe	<i>Aechmophorus occidentalis</i>	Whimbrel	<i>Numenius phaeopus</i>
		Long-billed curlew	<i>Numenius americanus</i>
		Ruddy turnstone	<i>Arenaria interpres</i>
		Black turnstone	<i>Arenaria melanocephala</i>
		Surf-bird	<i>Aphriza virgata</i>
<b>Tube Noses</b>		Sanderlings	<i>Calidris alba</i>
Northern fulmar	<i>Fulmarus glacialis</i>	Western sandpiper	<i>Calidris mauri</i>
Sooty shearwater	<i>Puffinus griseus</i>	Least sandpiper	<i>Calidris minutilla</i>
		Rock sandpiper	<i>Calidris pilocnemis</i>
<b>Storm-Petrels</b>		Dunlin	<i>Calidrus alpina</i>
Fork-tailed storm-petrel	<i>Oceanodroma furcata</i>	Red-necked phalarope	<i>Phalaropus lobatus</i>
Leach's storm-petrel	<i>Oceanodroma leucorhoa</i>		
<b>Pelicans</b>		<b>Gulls and Terns</b>	
Brown pelican	<i>Pelecanus occidentalis</i>	Pomarine jaeger	<i>Stercorarius pomarinus</i>
<b>Cormorants</b>		Parasitic jaeger	<i>Stercorarius parasiticus</i>
Double-crested cormorant	<i>Phalacrocorax auritus</i>	Long-tailed jaeger	<i>Stercorarius longicaudus</i>
Brandt's cormorant	<i>Phalacrocorax penicillatus</i>	Bonaparte's gull	<i>Larus philadelphia</i>
Pelagic cormorant	<i>Phalacrocorax pelagicus</i>	Heerman's gull	<i>Larus heermanni</i>
		Mew gull	<i>Larus canus</i>
<b>Hérons</b>		Ring-billed gull	<i>Larus delawarensis</i>
Great blue heron	<i>Ardea herodias</i>	California gull	<i>Larus californicus</i>
<b>Swans, Geese, Ducks</b>		Herring gull	<i>Larus argentatus</i>
Tundra swan	<i>Cygnus columbianus</i>	Thayer's gull	<i>Larus thayeri</i>
Greater white-fronted goose	<i>Anser allfrons</i>	Western gull	<i>Larus occidentalis</i>
Snow goose	<i>Chen caerulescens</i>	Glaucous-winged gull	<i>Larus glaucescens</i>
Brant	<i>Branta bernicla</i>	Black-legged kittiwake	<i>Rissa tridactyla</i>
Canada goose	<i>Branta canadensis</i>	Caspian tern	<i>Sterna caspia</i>
Green-winged teal	<i>Anas crecca</i>	Arctic tern	<i>Sterna paradisaea</i>
Mallard	<i>Anas platyrhynchos</i>	Common tern	<i>Sterna hirundo</i>
Northern pintail	<i>Anas actua</i>		
Northern shoveler	<i>Anas clypeata</i>	<b>Alcids</b>	
American wigeon	<i>Anas americana</i>	Common murre	<i>Uria aalge</i>
Canvasback	<i>Aythya valisineria</i>	Pigeon guillemot	<i>Cephus columba</i>
Scaup species	<i>Aythya species</i>	Marbled murrelet	<i>Brachyramphus marmoratus</i>
Harlequin duck	<i>Histrionicus histrionicus</i>	Ancient murrelet	<i>Synthliboramphus antiquus</i>
Black scoter	<i>Melanitta nigra</i>	Cassin's auklet	<i>Pychoramphus aleuticus</i>
Surf scoter	<i>Melanitta perspicillata</i>	Rhinoceros auklet	<i>Cerorhinca monocerata</i>
White-winged scoter	<i>Melanitta fusca</i>	Tufted puffin	<i>Fratercula cirrhata</i>
Common goldeneye	<i>Bucephala clangula</i>		
Bufflehead	<i>Bucephala albeola</i>	<b>Swallows</b>	
Common merganser	<i>Mergus merganser</i>	Northern rough-winged swallow	<i>Stelgidopteryx serripennis</i>
Red-breasted merganser	<i>Mergus serrator</i>	Barn swallow	<i>Hirundo rustica</i>
Ruddy duck	<i>Oxyura jamaicensis</i>	<b>Crows and Jays</b>	
		Northwestern crow	<i>Corvus caurinus</i>
		Common raven	<i>Corvus corax</i>
<b>Hawks and Eagles</b>			
Osprey	<i>Pandion haliaetus</i>	<b>Starlings</b>	
Bald eagle	<i>Haliaeetus leucocephalus</i>	European starling	<i>Sturnus vulgaris</i>
<b>Falcons</b>		<b>Songbirds</b>	
Merlin	<i>Falco columbarius</i>	Savannah sparrow	<i>Passerculus sandwichensis</i>
Peregrine falcon	<i>Falco peregrinus</i>		
		<b>Finches</b>	
<b>Plovers</b>		American goldfinch	<i>Carduelis tristis</i>
Black-bellied plover	<i>Pluvialis squatarola</i>		
Semipalmated plover	<i>Charadrius semipalmatus</i>		

Table 2. Marine Bird Species Additional to those Listed in Table 1 Occurring in or near Sanctuary Boundary.  
Source: Speich et. al., 1987.

**Common Name  
Genus/Species**

Loons

Yellow-billed loon  
*Geia adamsii*  
Arctic loon  
*Geia immer*

Tube Noses

Short-tailed albatross  
*Diomedea albatrus*  
Laysan albatross  
*Diomedea immutabilis*  
Black-footed albatross  
*Diomedea nigripes*  
Buller's shearwater  
*Puffinus bulleri*  
Flesh-footed shearwater  
*Puffinus carneipes*  
Pink-footed shearwater  
*Puffinus creatopus*  
Manx shearwater  
*Puffinus puffinus*  
Short-tailed shearwater  
*Puffinus tenuirostris*

Storm-Petrels

Least storm-petrel  
*Halocpterna microsom*  
Wilson's storm-petrel  
*Oceanites oceanicus*  
Ashy storm-petrel  
*Oceanodroma homochroa*  
Mottled petrel  
*Teredroma inexpectata*  
Solander's petrel  
*Teredroma solandri*  
Murphy's petrel  
*Teredroma ultima*

Pelicans

American White Pelican  
*Pelecanus erythrorhynchos*

Cormorants

Red-faced cormorant  
*Phalacrocorax urile*

Swans, Geese, Ducks

Barrow's Goldeneye  
*Bucephala clangula*  
Oldsquaw  
*clangula hyemalis*

Shorebirds

Northern phalarope  
*Lobipes lobatus*

Gulls and Terns

South polar skua  
*Catharacta skua*  
Laughing gull  
*Larus atricilla*  
Glaucous gull  
*Larus hyperboreus*  
Slaty-backed gull  
*Larus schistisagus*  
Ivory uil  
*Pagophila eburnea*  
Red-legged kittiwake  
*Rissa brevirostris*  
Ross's gull  
*Rhodostethia rosea*  
Aleutian tern  
*Sterna aleutica*  
Elegant tern  
*Sterna elegans*  
Forster's tern  
*Sterna forsteri*  
Sabine's gull  
*Xema sabini*

Alcids

Crested auklet  
*Aethia cristatella*  
Least auklet  
*Aethia pusilla*  
Whiskered auklet  
*Aethia pygmaea*  
Kittlitz's murrelet  
*Brachyramphus brevirostris*  
Black guillemot  
*Cappus grylle*  
Parakeet auklet  
*Cyclorhynchus psittacula*  
Xantus' murrelet  
*Endomychura hypoleuca*  
Horned puffin  
*Fratercula corniculata*  
Thick-billed murre  
*Uria lomvia*

the area. In fact, Puget Sound and the outer Washington coast are the sole breeding areas for the glaucous-winged gull in the contiguous U.S. (SAB, 1990). The surf scoter is a resident species that does not nest in the area, but non-breeding young birds remain here during the spring and summer months, while adults go north to nest.

Summer visitors are present during the spring and/or summer and usually absent during the winter. Summer residents may or may not breed in the area. Summer resident species that nest in the area include Leach's storm-petrel, osprey, snowy plover, spotted sandpiper, and Caspian tern. Summer resident species that do not nest in the area include sooty shearwater and Heermann's gull.

Winter visitors are present during the winter, and spring or fall, or both, and usually absent during the summer. Examples include the loons and grebes, swans, geese, brandt, most ducks, scoters, most shorebirds, herring gull, Thayer's gull, and black-legged kittiwake. Many species that are classified as winter visitors could also be classified non-breeding resident species, on the basis of small numbers of non-breeding individuals present during the summer period. Non-breeding common loons, Pacific loons, Western grebes, surf scoters, and black scoters are present in Washington coastal waters during the summer.

Migrants are generally only present during the spring or fall migration periods, or both. Examples include white-fronted geese, several shorebirds, phalaropes, pomarine and parasitic jaegers, California gulls, Sabine's gulls, and Arctic terns. Individual brown pelicans disperse up the Pacific coast from breeding colonies in Baja California, Mexico, and southern California, in late summer and fall, but by the end of the year nearly all birds have departed coastal Washington for southern waters. Heermann's gulls have an identical pattern, but it occurs earlier, in the summer and early fall period.

Seven marine bird species present in Washington waters are listed as threatened or endangered. The short-tailed albatross, peregrine falcon, brown pelican, and Aleutian Canada goose are all on the Federal endangered species list (although the short-tailed albatross is not yet regarded as endangered within the U.S.). The bald eagle is listed as a threatened species, and Grays Harbor is one of two major adult concentrations on the west coast. The State of Washington lists the snowy plover and American white pelican as endangered species. The marbled murrelet may soon be considered as an active candidate for

listing as a threatened or endangered species.

The marine birds of the Washington coast may be divided into four groups, based loosely on their geographic distribution and feeding habits:

- \* Seabirds, such as alcids, shearwaters and gulls, which feed in open waters from the shoreline and estuaries to the open ocean. Some seabirds are strictly pelagic, while others prefer the nearshore environment;
- \* Shorebirds, such as sandpipers, which feed mainly along the intertidal and nearshore marine environment;
- \* Waterfowl, such as ducks and geese, found near shore on the open coast and in estuaries;
- \* Birds of prey, such as bald eagles and peregrine falcons, which breed and roost on land near water bodies, and feed in or near the water. (Strickland & Chasan, 1989)

As with the other living resources of the Sanctuary, marine birds are often associated with specific habitats. In general, seabird activity is most concentrated along the Olympic coast, while shorebirds and waterfowl are found primarily in the bays and shallow waters of the southern coast. All of the major seabird colony sites (15 with >1000 birds) along the outer coast are from Point Grenville to Cape Flattery. Alternately, Willapa Bay and Grays Harbor are critical as resting and foraging areas for several million migratory shorebirds and over one hundred thousand waterfowl. Birds of prey exist in very small numbers compared to the other marine bird categories and, though found throughout the study area, nest primarily on rugged terrain along the Olympic coast and at the mouth of the Columbia River. To determine bird species composition for specific habitats of the Washington coast, consult the species lists in Appendix C. Note that marine bird species interact at several trophic levels of the food web. This fact makes them a vital component of the coastal ecosystem.

## 1. Seabirds

The seabird colonies of Washington's outer coast are among the largest in population in the continental United States (Cummins, in Strickland and Chasan, 1989). The category "seabirds" refers to bird species that spend much of their lifecycle at sea. These birds inhabit sanctuary waters in greater number and frequency than any other marine birds. They also constitute the largest population of nesting marine birds within the proposed sanctuary boundaries.

Seabirds include those that are pelagic (i.e. generally forage far offshore over the continental shelf, continental slope, and in oceanic waters) and those that feed in nearshore zones. Pelagic seabirds go ashore primarily to breed, and

otherwise rarely visit land. Pelagic species include the northern fulmar, five species of shearwaters, black footed albatross, arctic tern, pomarine jaeger, and fork-tailed and Leach's storm-petrels. The sooty shearwater is by far the most numerous. Huge flocks estimated to approach one million birds have been observed at the entrance to the Strait of Juan De Fuca during summer months (Strickland and Chasan, 1989). Nearshore seabirds feed within sight of land and include Pacific and red-throated loons, western grebes, brown pelicans, several species of gulls and cormorants, tufted puffins, common murre, and red-necked phalaropes.

A recent study for the US Department of Interior (MMS, 1992) describes offshore seabird activity in the Northwest as follows:

Seabird populations were found to be most densely concentrated over the continental shelf and least so seaward of the continental slope (i.e., waters deeper than 2,000 m). During late spring through late summer, the shearwaters, storm-petrels, gulls, Common Murres and Cassin's Auklets numerically dominated the fauna. All these except the shearwaters nest in the study area. With autumn migration, the importance of shearwaters and petrels declined, but the number of phalaropes, California Gulls, and fulmars increased. Phalaropes, California Gulls, and fulmars, together with other gulls, murre, auklets, and kittiwakes, constituted the major elements of the winter fauna. Although total population estimates have not been attempted in this report, there is no doubt that peak populations in Oregon and Washington reach into the millions of birds.

Every area over the shelf harbored dense concentrations of birds during the year. However, a few locations stood out prominently. The major colony complexes were located in southern and northern Oregon and along the Olympic Peninsula of Washington. Offshore of these sites, nesting birds foraged in dense aggregations to about 50 km radius. Petrels, shearwaters, and alcids heavily used the shelf-edge banks off central Oregon and northern Washington. The broad shelf area of northern Washington consistently harbored large populations of shearwaters, gulls, murre, and auklets.

The report findings demonstrate that foraging activity is significant throughout the study area to the shelf break and beyond. Swiftsure Bank and the Juan de Fuca Canyon stand out in the data as intense foraging sites. The 50 km foraging range of nesting birds extends, within the study area, from the international border to the Grays Harbor/Willapa Bay area. Strong topographically induced upwelling is known to occur along the shelf of southwestern Vancouver Island, particularly at the

edge of the Juan de Fuca Canyon. Oceanic fronts, areas of strong horizontal property gradients, often occur at the seaward edges of coastal upwellings. These stratified water density layers trap poorly mobile zooplankton upon which some seabird species feed (MMS, 1992).

The coastal rocks and islands along the outer coast are critical nesting and roosting sites for many seabird species (See Appendix C, Figure 15 for ratings of significance to several species). All major seabird nesting sites along the Washington coast have been identified. Most are located on headlands or islands protected by the USFWS, the NPS, or native tribes.

The colony site is a very critical habitat for seabirds because reproduction and thus continuation of species depend on these sites. Here, the population will reach its annual low, just before young are hatched, and its annual high, just after hatching. At other times of the year, seabirds may be able to avoid problems, such as disruption of food supplies and perhaps even large oil spills, simply by flying elsewhere, but for successful reproduction, they are limited to the area in the vicinity of the colony.

Colonial seabird populations in the study area are estimated to range from 108,530 breeding pairs (Strickland and Chasan, 1989) to 240,000 individuals (Wahl, 1984). Approximately 75% of the total estimated colonial seabird population in Washington breed between Point Grenville and Neah Bay which is in, or adjacent to, subarea 4 (Figure 33). The shoreline south of Point Grenville, in or adjacent to subarea 7, has limited nesting habitat available for colonial seabirds, except for accreted sand islands in Grays Harbor and Willapa Bay and the rock cliff face at the mouth of the Columbia River (Speich and Wahl, 1989).

Figure 34 displays the location and density of breeding seabirds along the Washington coast. This data reveals a distinct difference in profile between the breeding seabird populations along the Olympic coast and those of the southern coast (Grays Harbor/Willapa Bay). The Olympic coast is dominated by the more pelagic species and much higher numbers of nesters, while the southern coast is primarily nesting habitat for gulls and terns. There is an obvious break in nesting activity between Ocean Shores and Point Grenville that coincides with a distinct change in habitat. These characteristics are also evident by the distribution of individual nesting colonies in Figure 35. The dominant species of breeding seabirds in Washington are Cassin's auklets, rhinoceros auklets, common murrelets, Leach's storm-petrels, glaucous-winged gulls and tufted puffins (Figure 36). Destruction Island is home to one of the seven major colonies (18,000 pairs) of rhinoceros auklets in the world, and only one of two major colonies of greater than 20,000 birds along the entire west coast (SAB, 1990). The rhinoceros auklet, Fork

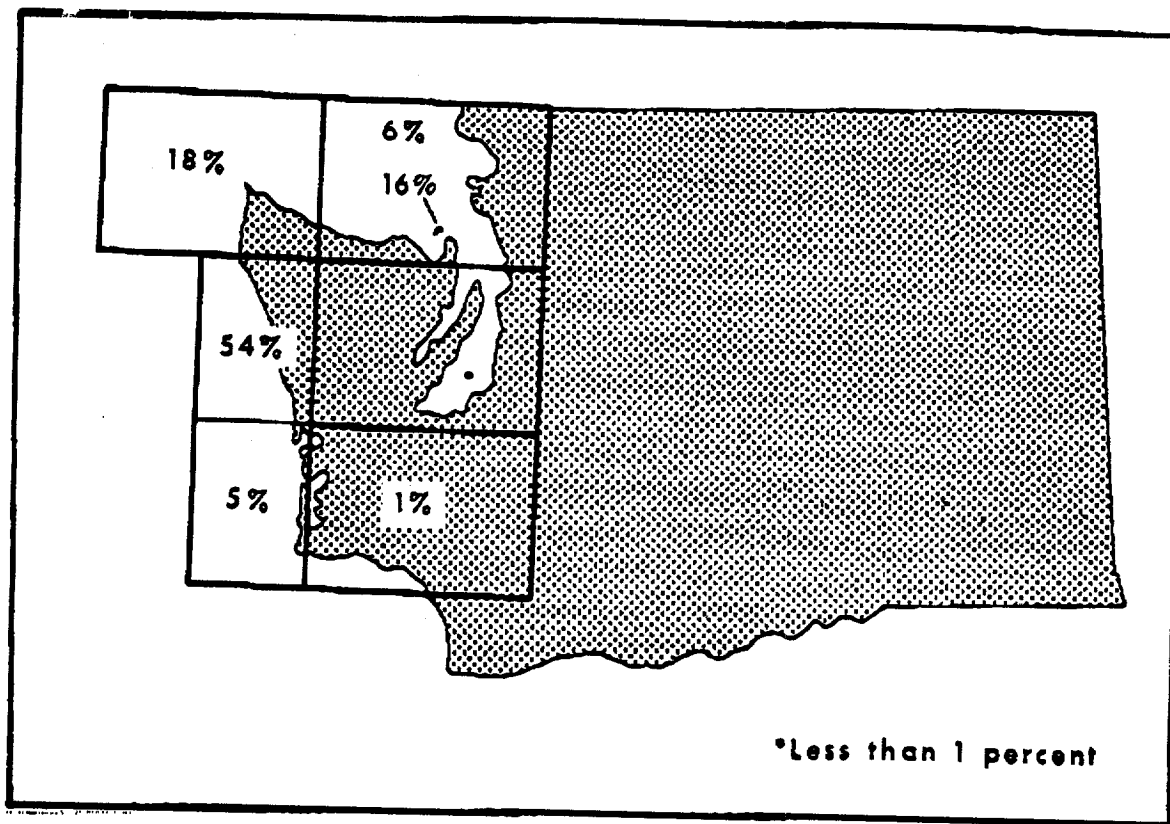


Figure 33. Percentage of Breeding Seabirds along the Marine Shorelines of Washington (Speich and Wahl, 1989).

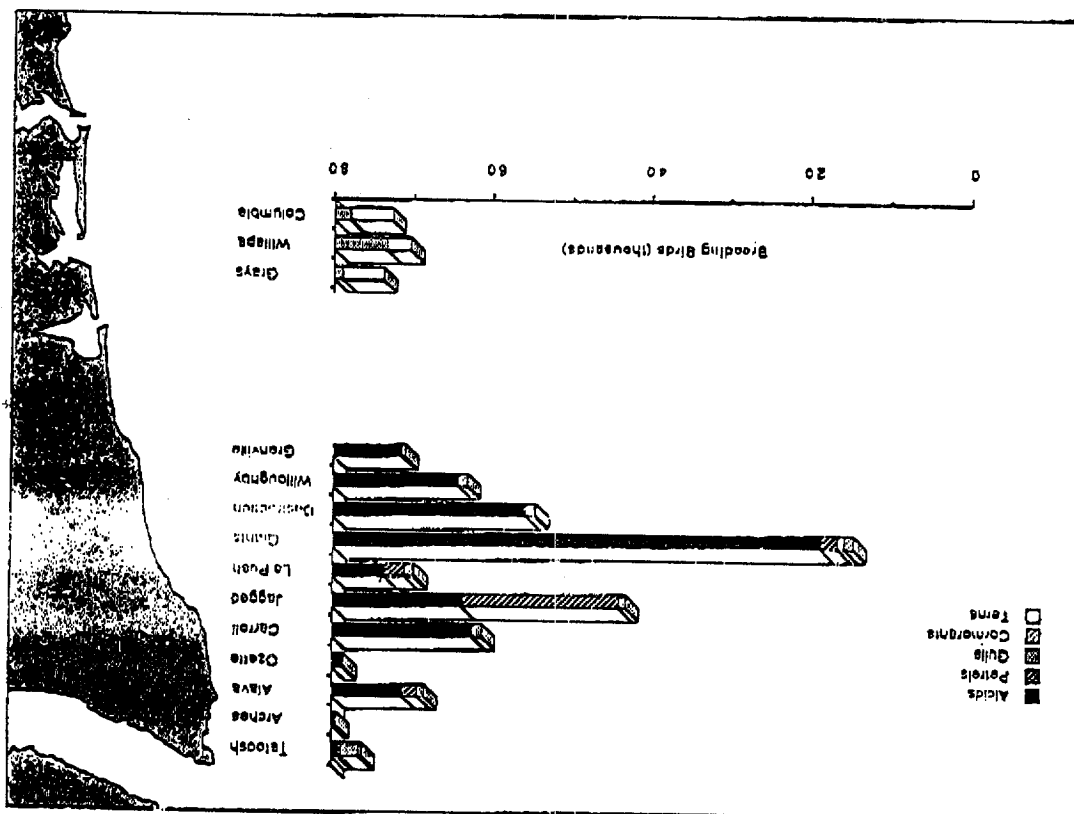


Figure 34. Estimated Breeding Populations (numbers of individuals) of Seabird Families (alcids, storm-petrels, cormorants, and terns) by Region along Coastal Washington (Strickland and Chasan, 1989 from data in Speich and Wahl, 1989).

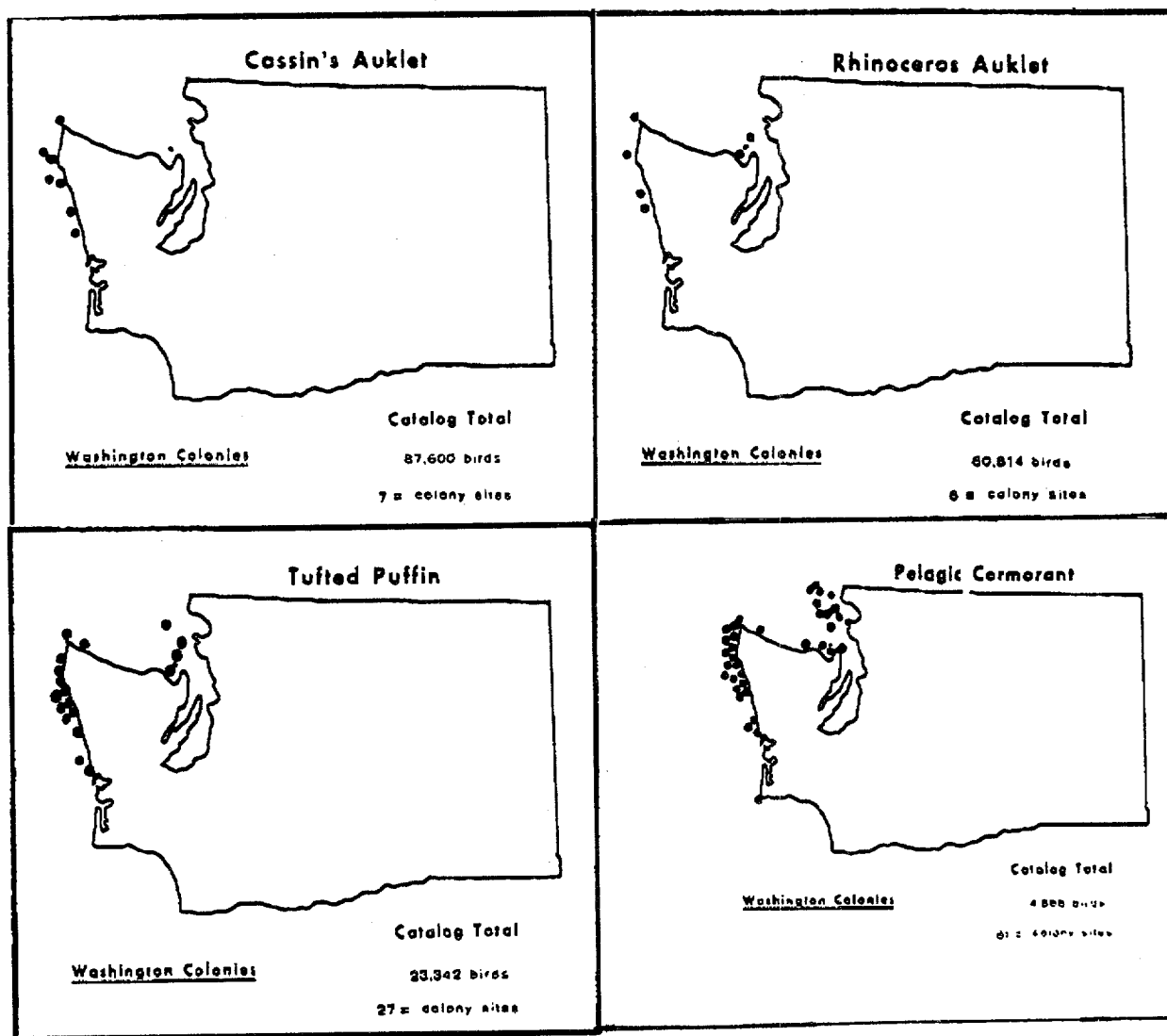


Figure 35. Distribution of Nesting Sites of the Washington Species of seabirds (Speich and Wahl, 1989).

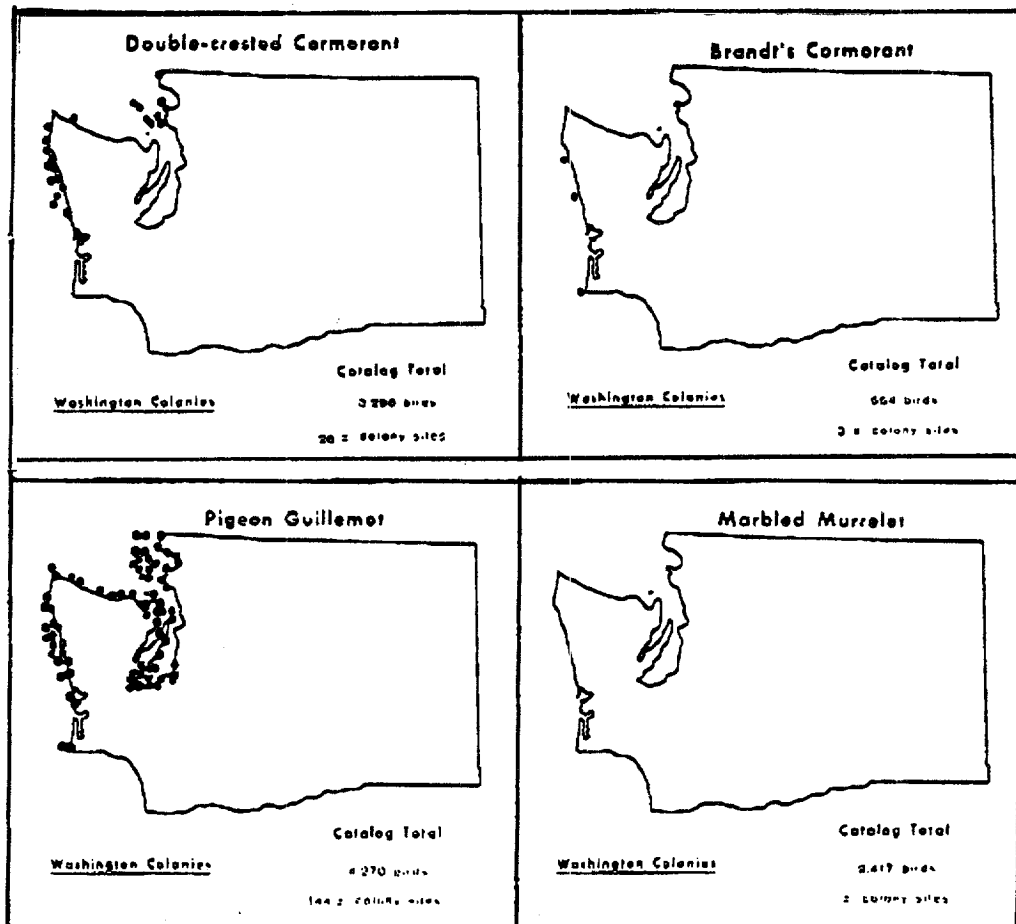


Figure 35. continued

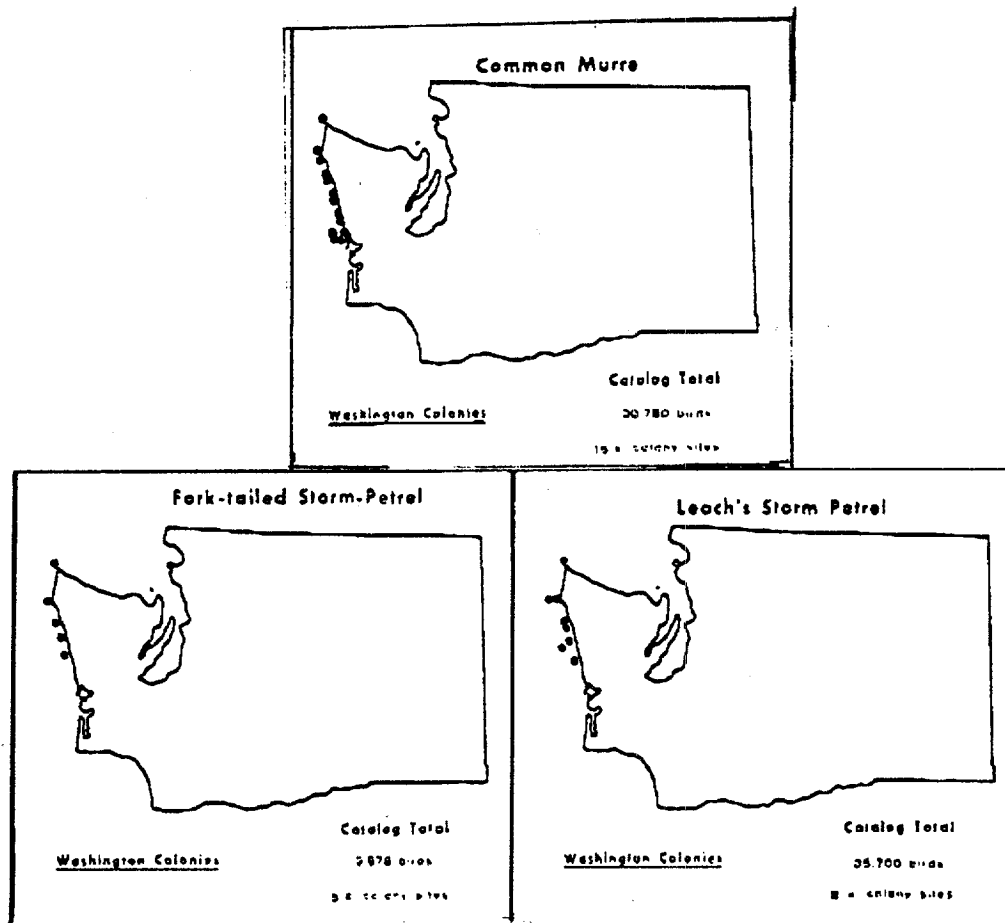


Figure 35. continued.

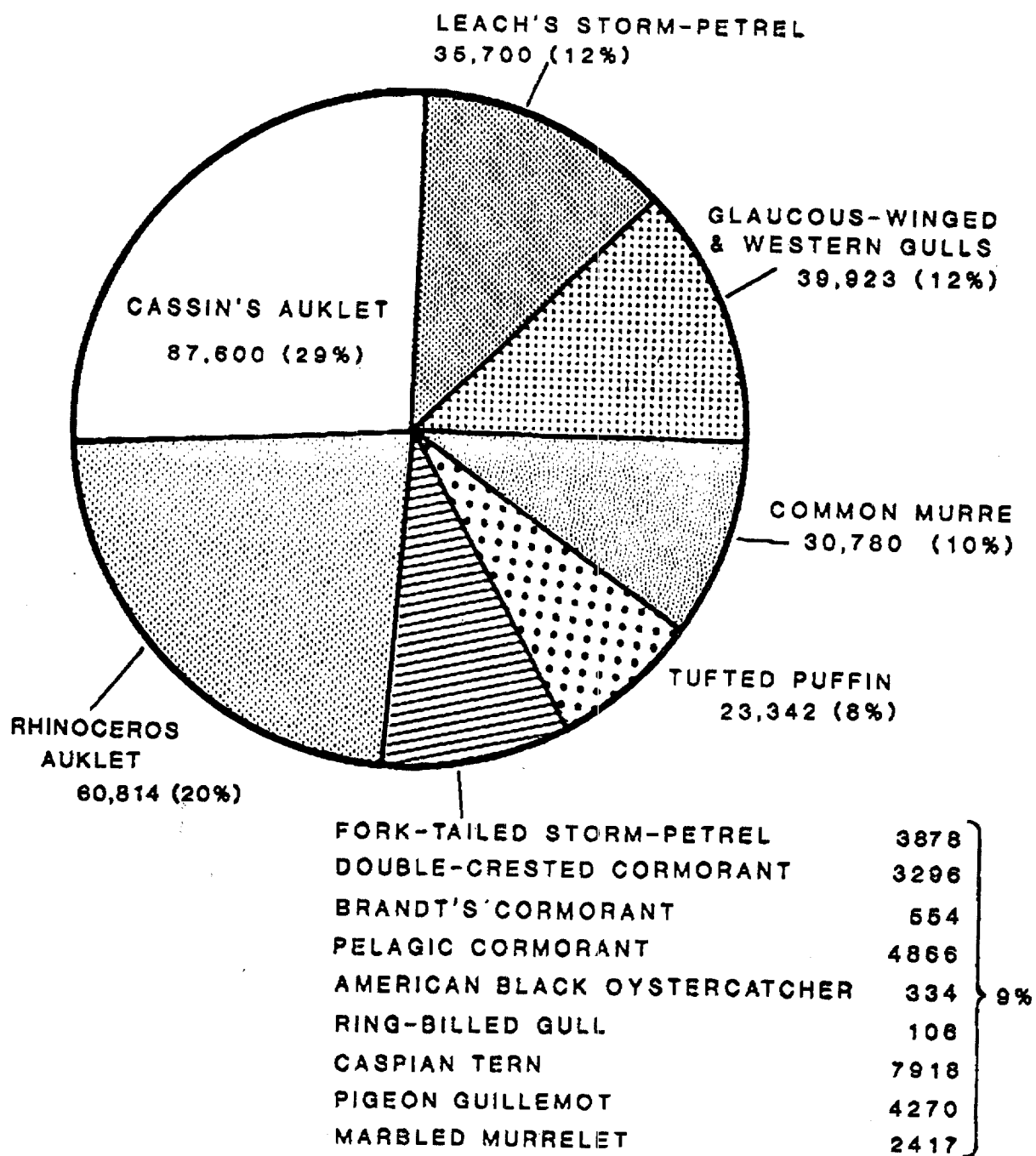


Figure 36. Populations of Breeding Seabirds and Percentages of Total Aggregate Population in Washington (Speich and Wahl, 1989).

-tailed storm petrel, Brandt's cormorant, and caspian tern are all restricted to very few nesting sites (Speich and Wahl, 1989). Other species that breed on these coastal rocks and islands include terns, cormorants, black oystercatchers, ring-billed and western gulls, pigeon guillemots, and ancient marbled murrelets.

Alcids are a distinctive family of seabirds present along the Washington coast that includes the tufted puffin, rhinoceros auklet, cassin's auklet, common murre ancient and marbled murrelets, and pigeon guillemot. They are colonial nesters, live long lives, and reproduce very slowly. Adults do not reach sexual maturity for several years, and then produce only one to two eggs per clutch. Also, breeding birds will not necessarily mate each year. Most alcids are found in shallower nearshore waters, especially in summer when birds are closely tied to nesting sites. Large colonies of tufted puffins, rhinoceros auklets, Cassin's auklets and common murres are present on the nearshore islands of the Olympic coast. Except for Cassin's auklets (nocturnal during breeding), birds are often seen roosting and gathering about the colonies. Foraging areas differ somewhat for each species. Cassin's auklets and tufted puffins are commonly found foraging over the continental slope. Rhinoceros auklets may forage in these areas but also regularly forage in closer nearshore waters, and in Grays Harbor. Common murres, like rhinoceros auklets, fly considerable distances to foraging areas up and down the coast, and are also seen from Grays Harbor south to the Columbia.

The traits and sensitivities of the common murre are in many ways typical of species within the alcid family. Common murres are among the most colonial species of seabirds. They nest on open rock or dirt ledges of coastal islands and narrow ledges of vertical cliffs. A pair of common murres will produce only one egg per year. The oblong egg is layed on bare rock and is held between the legs of the parent. Common murres nest at 18 locations along the Olympic outer coast and sometimes shift colony sites. These birds are strong fliers and are capable of foraging long distances from their colonies. They dive to considerable depths to capture fish, crustaceans, and cephalopods. In late summer and fall, adult females of the Washington coastal population fly into Puget Sound to molt and winter. Meanwhile, adult males accompany their newly fledged chicks to sea, staying with them and feeding them for several weeks. The chicks fledge when small and are unable to fend for themselves. While migrating, the adult murres undergo a complete molt rendering them flightless. The males and their fledgling chicks swim north and enter Puget Sound through the Strait of Juan de Fuca.

Common murres are highly vulnerable to oil contamination, particularly during the migration phase for males and chicks. Since these birds are flightless and completely dependent upon

marine prey, they remain in the water where they can become immobilized and encased by oil. Preening can lead to ingestion of oil and toxic effects. Entire colonies could be devastated by a local oil spill occurring at the time the birds are departing nest sites for the water migration to Puget Sound. Nesting murres are particularly sensitive to disturbance by boats, low-flying aircraft, and humans on foot as well. When disturbed, adults flush from the colonies and may inadvertently destroy chicks and eggs held between their legs. The remaining chicks and eggs are subject to increased predation from gulls, ravens and crows. Studies by B. Tschanz in 1959 concluded that murres can lay a second or third egg if previous eggs are destroyed in a given season. However, chicks hatching later in the season are likely to have lower survival rates (Wilson, 1993).

There are many threats to the populations of breeding seabirds in Washington. They include disturbance of nesting areas by recreation, military operations, and domestic animals; loss of habitat and/or decline in the population of prey species; entanglement in fishing nets, particularly gill nets; and oil pollution. A negative impact on seabird populations may not be realized immediately for several reasons. One is that seabirds have long life spans, commonly between 20 and 30 years. Some more longer lived species may even have a breeding life of 50 years. Secondly, recruitment to breeding populations is slow and delayed. Many seabirds spend at least two years, commonly three, and up to 9 years as non-breeders. Thirdly, clutch size is small (1-5), compared to land birds (7-15). Long breeding lives, low recruitment rates, and delayed maturity mask the detection of effects on successive breeding populations for several years. This underscores the need to monitor seabird populations regularly to detect impacts of chronic pollution, habitat loss, oil spills, and other environmental disasters (Wahl, 1984).

The effects of disturbance are often subtle and easily overlooked by the casual observer, yet are often devastating to the birds. Impacts range from slight disruption of courtship behavior, incubation, and feeding of nestlings by adults, to outright mortality of nestlings from exposure to heat or cold, and induced predation by rival adult birds or by other species (Speich & Wahl, 1989). Each seabird species is sensitive to a unique set of factors and the particular timing of any disturbance. Some species have greater tolerance levels than others.

Encroachment on seabird colonies by humans or domestic animals (whether for recreational purposes or otherwise) can cause prolonged disruption of nesting sites, resulting in increased mortality rates. Dogs are particularly disruptive to nesting birds and can be disastrous to a colony. Marine recreational activities can cause repeated disruptions that may eventually lead to abandonment of nests or entire colony sites.

The intense activity (noise, motion, spotlights) surrounding search and rescue operations can frighten adults from colonies for several hours. The sudden loud noise of low-flying jet aircraft panics nesting birds from nest sites and particularly affects cormorants, common murre and tufted puffins.

The above disturbances can also impact birds at favored foraging and roosting sites. Additional activities that may directly or indirectly affect foraging seabirds are physical alterations of the benthos (e.g. dredging, filling, dumping) and fishing practices. Alteration of benthic habitat can reduce the carrying capacity of the area for prey species important to seabirds. Fishing can also deplete prey abundance and directly damage birds that are caught in nets.

Seabirds, especially pelagic, are particularly sensitive to impacts from marine oil spills. Clark (1989) effectively describes the impacts of oil on seabirds:

Unlike most other organisms in the sea, sea birds are harmed through the physical properties of floating oil, and the toxicity of its constituents is of minor importance. If liquid oil (or any other surface-active substance) contaminates a bird's plumage, its water-repellant properties are lost. If the bird remains on the sea, water penetrates the plumage and displaces the air trapped between the feathers and the skin. This air layer provides buoyancy and thermal insulation. With its loss, the plumage becomes waterlogged and the birds may sink and drown. Even if this does not happen, the loss of thermal insulation results in a rapid exhaustion of food reserves in an attempt to maintain body temperature, followed by hypothermia and, commonly, death. Birds attempt to free their plumage of contaminating oil by preening and they swallow quantities of it. Depending on its toxicity, the oil may then cause intestinal disorders and renal or liver failure. Quite small quantities of oil ingested by birds during the breeding season depress egg-laying, and of the eggs that are laid the proportion that hatch successfully is reduced. If oil is transferred from the plumage of an incubating bird to the eggs, the embryos may be killed.

Indirect effects of oil pollution on reproduction appears to be much less important than the direct mortality of adult birds, and most attention has been directed towards the latter problem. The species most commonly affected are auks: guillemots (murre), razorbills and puffins; and some diving sea-ducks: scoters, velvet scoters, long-tailed ducks (old squaw), and eiders. These birds spend most of their time on the surface of the water and so are particularly likely to encounter floating oil, and because they dive rather than

fly up when disturbed, they are as likely as not to resurface through the oil slick, so becoming completely covered with oil. Furthermore, these ducks are extremely gregarious except when ashore for breeding, and the auks are gregarious at all times of the year. Thus, if there are casualties they are likely to be numerous. Indeed quite small oil slicks drifting through concentrations of birds resting on the sea may inflict heavy casualties quite disproportionate to the quantity of oil. Thus, when 230,000 t of crude oil was lost from the Amaco Cadiz on the Brittany coast, the known sea bird casualties numbered 4572; but the largest known kill of sea birds from oil pollution was in the Skagerrak [an arm of the North Sea between Denmark and Norway] in January 1981 when 30,000 oiled birds appeared on the beaches, and this appears to have been caused by small amounts of oil discharged by two vessels. Indeed, the estimated loss of 12,000 birds on the north-east coast of England in January and February 1970 from oil slicks that were never even identified, equals the estimated loss following the wreck of the Torrey Canyon [the second largest tanker spill to date - 860,000 barrels in 1967].

In total, over 500,000 seabirds (juveniles included) are concentrated within Washington nesting colonies each year. Over 325,000 colonial seabirds are found in subarea 4 and about 45,000 are present in colonies in subarea 7. The remainder are found in inland waters (SAB, 1990). Those species for which the study area is particularly important are the black-legged kittiwake, the rhinoceros auklet, and the tufted puffin. Additionally, nesting colonies along the outer coast of Washington contain more than 50% of contiguous U.S. west coast total populations for the following species: Fork-tailed storm-petrel, Caspian tern, Cassin's auklet, and tufted puffin.

## ii. Shorebirds

Shorebirds do not swim, but rather wade or probe at the waters edge, feeding on shallow-water organisms or prey in the intertidal mud or sand. Shorebirds such as western sandpipers, sanderlings, dunlin, and semi-palmated and black-bellied plovers roost and forage along coastal beaches and bays during their annual migrations.

While most shorebirds tend to feed on sandy beaches or mudflats, several species prefer to forage on rock substrate and are consistently found on rocks and islands of the Olympic coastal region. Representatives of this group include ruddy and black turnstones, wandering tattler, surfbird, and rock sandpiper (see Trophic Level (9), Appendix F). They pass through during migrations, but small numbers of three species winter in these rocky surf areas of the coast (Strickland and Chasan, 1989).

Unlike seabirds, most shorebirds are not associated with the marine environment during the breeding season, but nest on coastal and interior wetlands. A few species nest in small numbers in the Grays Harbor/Willapa Bay region. These include the snowy plover, killdeer, semi-palmated plover, and common snipe.

Shorebirds depend upon critical staging sites along the coast during migrations. Coastal bays and estuaries along the Washington outer coast (i.e. Grays Harbor and Willapa Bay) are important feeding and resting areas for large concentrations of birds during migration and the winter season. These areas are the last estuaries at which many birds stop during their migration to Alaska. Over 12 species of shorebirds stage in the spring with numbers greater than 1,000,000 in the Grays Harbor area, and 750,000 in Willapa Bay. Approximately 30,000 shorebirds overwinter in Willapa Bay. These are also important areas for the endangered peregrine falcons, which prey on many of the shorebirds (McMinn, 1993).

#### iii. Waterfowl

Waterfowl are flat-billed birds that spend the majority of their lifecycle on the water. Like shorebirds, waterfowl typically breed on freshwater habitats, but many species move to shoreline and nearshore habitats when breeding is complete. Many species of waterfowl stage and winter in Washington's protected marine waters. Approximately 10,000 ducks and geese overwinter in Willapa Bay, with numbers swelling during migrations to greater than 100,000. Approximately 20,000 waterfowl migrate through Grays Harbor (Atkinson, 1993). Very small numbers of geese and ducks remain to nest in these two areas during the spring and summer.

Other species, such as scoter, harlequin, bufflehead, merganser, goldeneye, oldsquaw, and scaup, winter in the nearshore waters of the open coast. Scoters are by far the most numerous species of sea ducks in nearshore waters. A small number of sub-adult birds are found in the area during the summer, soon joined by large numbers of adults from northern continental nesting areas. The sub-adult birds pass through a flightless period when they molt their feathers. At this time, flocks numbering tens of thousands are found scattered along the coast. At least 100,000 and possibly up to 300,000 birds molt in the area between Point Grenville and Destruction Island. After molting is completed, many birds may disperse down the Pacific coast, but scoters are found in Washington coastal waters throughout the winter (Strickland and Chasan, 1989).

#### iv. Birds of Prey

Peregrine falcons and bald eagles nest and feed extensively

along Washington's coastal waters. The Washington Department of Wildlife (WDOW) Nongame Program counted 17 pairs of nesting peregrine falcons in the state in 1991. Nine of the 17 pairs nested on the outer coast. Peregrines prefer steep cliffs for nesting. Shorebirds are a favored food source for these birds of prey. Large flocks of migrating shorebirds at Grays Harbor attract peregrines from distant nesting sites along the coast. Peregrine falcons continue a slow, steady recovery in Washington and do not show evidence of serious biochemical contamination as do populations in California and Oregon (WDW, 1991). Their low numbers require that particular attention be given to preserving habitat and minimizing disturbance. The peregrine falcon is listed as an endangered species by Washington State as well as the Federal government.

A continuous band of bald eagle nests have been established along the entire shoreline of the study area, including the shoreline of the Strait of Juan de Fuca. The nesting territories are contiguous to one another, with nests approximately 1 mile apart (Taylor, 1992). The eagles patrol the coastline for fish, waterfowl and prey of opportunity. The bald eagle population in Washington appears to be in good health and is growing annually. The WDOW Nongame Program counted 426 active nests along western Washington waterways in 1991 (WDW, 1991). There are 51 breeding territories along the coastal boundary of the Sanctuary between Copalis Rock and Koitlah Point (WDW, 1993). The bald eagle in Washington State is listed as threatened by both the Federal government and the State of Washington.

A special report by the NOAA SAB (1990) analyzed marine bird populations based on ecological considerations such as breeding sites, staging areas, and foraging areas (Appendix C, Tables 7 and 8). Two observations are noteworthy. First, subareas 4 and 7 are most significant to the overall distribution of marine birds. This reflects the importance of colony sites along the rocky headlands in subarea 4, and the staging areas that serve as the last major stop-over on the Pacific flyway before the seabirds fly to Alaska.

#### (f) Marine Mammals

A total of 30 species of marine mammals are reported to occur in the coastal waters of Washington (Table 3). The distribution of a selected species of marine mammals in the seven subareas is shown in Appendix D, Table 9. Of these, seven are considered common: California sea lions, northern sea lions (although their numbers have decreased and they have become listed as threatened species), harbor seals, harbor porpoises, gray whales, Risso's dolphin, and Pacific white-sided dolphin. The river otter, usually associated with freshwater rivers and lakes, has adapted to the local marine environment. Species which are known to breed in the sanctuary study area include the

Table 3. Marine Mammal Species Reported From The Coastal Waters of Washington (Source: Speich et. al., 1987; Strickland and Chasan, 1989; and Schmitten, 1993).

Order	Species	Occurrence	Legal Status
Carnivora	Sea otter, <i>Enhydra lutris</i>	R	WAC, MMPA, ESA, WSE
Pinnipedia	Ca. sea lion, <i>Zalophus californianus</i>	C	WAC, MMPA
	N. sea lion, <i>Eumetopias jubatus</i>	C	WAC MMPA
	N. fur seal, <i>Callorhinus ursinus</i>	R	WAC, MMPA
	Pacific harbor seal, <i>Phoca vitulina</i>	C	WAC, MMPA
	N. elephant seal, <i>Mirounga angustirostris</i>	R	WAC, MMPA
Cetacea	Ca. gray whale, <i>Eschrichtius robustus</i>	C	WAC, MMPA, ESA
	Right whale, <i>Eubalaena glacialis</i>	A	WAC, MMPA, ESA
	Minke whale, <i>Balaenoptera acutorostrata</i>	R	WAC, MMPA
	Fin whale, <i>Balaenoptera physalus</i>	A	WAC, MMPA, ESA
	Sei whale, <i>Balaenoptera borealis</i>	A	WAC, MMPA, ESA
	Blue whale, <i>Balaenoptera musculus</i>	A	WAC, MMPA, ESA
	Humpback whale, <i>Megaptera novaeangliae</i>	R	WAC, MMPA, ESA
	Sperm whale, <i>Physeter macrocephalus</i>	R	WAC, MMPA, ESA
	Pygmy sperm whale, <i>Kogia breviceps</i>	A	WAC, MMPA
	N. Pacific beaked whale, <i>Mesoplodon stejnegeri</i>	A	WAC, MMPA
	Hubb's beaked whale, <i>Mesoplodon carlhubbsi</i>	A	WAC, MMPA
	Cuvier's beaked whale, <i>Ziphius cavirostris</i>	A	WAC, MMPA
	Baird's beaked whale, <i>Berardius bairdii</i>	A	WAC, MMPA
	Pilot whale, <i>Globicephala macrorhynchus</i>	A	WAC, MMPA
	Risso's dolphin, <i>Grampus griseus</i>	A	WAC, MMPA
	Killer whale, <i>Orcinus orca</i>	R	WAC, MMPA
	False killer whale, <i>Pseudorca crassidens</i>	A	WAC, MMPA
	Common dolphin, <i>Delphinus delphis</i>	A	WAC, MMPA
	N. right whale dolphin, <i>Lissodelphis borealis</i>	A	WAC, MMPA
	Striped dolphin, <i>Stenella coeruleoalba</i>	A	WAC, MMPA
	Pacific white-sided dolphin, <i>Lagenorhynchus obliquidens</i>	A	WAC, MMPA
	Dall's porpoise, <i>Phocoenoides dalli</i>	R	WAC, MMPA
	Harbor porpoise, <i>Phocoena phocoena</i>	C	WAC, MMPA, WST

C = Common R = Rare A = Accidental

WAC - Washington Administrative Codes  
MMPA - U.S. Marine Mammal Protection Act  
ESA - U.S. Endangered Species Act  
WSE - Washington State Endangered Species  
WST - Washington State Threatened Species

sea otter, harbor seal, and harbor porpoise. Four species, the northern sea lion, California sea lion, northern fur seal, and gray whale are regular seasonal migrants along the coast.

Marine mammals listed on the Federal threatened and endangered species list include gray, right, fin, sei, blue, humpback, and sperm whales, and the northern (Steller) sea lion (listed as a threatened species under the ESA by final rule on November 26, 1990). The sea otter is listed as a Washington State endangered species; the harbor porpoise is listed as a Washington State threatened species.

Some species of cetaceans (whales and porpoises) are found along the Washington coast during the entire year. The most frequently observed are the harbor porpoise, Pacific white-sided dolphin, Risso's dolphin and California gray whale. The harbor porpoise is a year-round resident that often inhabits bays and inshore waters, however its shyness makes it difficult to acquire accurate population data. Aerial and ship surveys conducted between 1984 and 1986 estimated a population of about 45,000 animals along the coasts of California, Oregon, and Washington (Osmeck, 1993).

The gray whale is primarily a coastal, nearshore species usually found in water depths of less than 50 meters. Its range extends from breeding grounds off Baja California to major feeding areas in the Bering and Chuckchi Seas. They are most abundant along the Washington outer coast during northward migration from February through April, and southward migration from October through December. The population of Eastern North Pacific gray whale is estimated to be about 21,000 animals (Jones et al., 1984; Reilly et al., 1983). Annually, ten to fifteen individuals remain as summer residents near Kalaloch, Cape Alava, and Cape Flattery.

Other cetaceans regularly observed in coastal or offshore waters include killer whales, Dall's porpoise and Minke whales. Humpback, blue, and sperm whales are seen offshore during the summer months, but these sightings are rare. The right whale is an extremely endangered species with an estimated population of only 200 in the entire North Pacific Ocean.

Pinnipeds (seals and sea lions) found along the outer coast include the California sea lion, northern sea lion, northern fur seal, Pacific harbor seal, and the northern elephant seal. The distribution of pinniped haulout sites is shown in Figure 37. Harbor seals are the most abundant pinniped in coastal Washington. They are year-round residents of both offshore and inshore waters and the only pinnipeds that breed in Washington.

Harbor seals use nearshore rocks, reefs, and sand bars for rookery and haulout sites. They frequent logs and floating

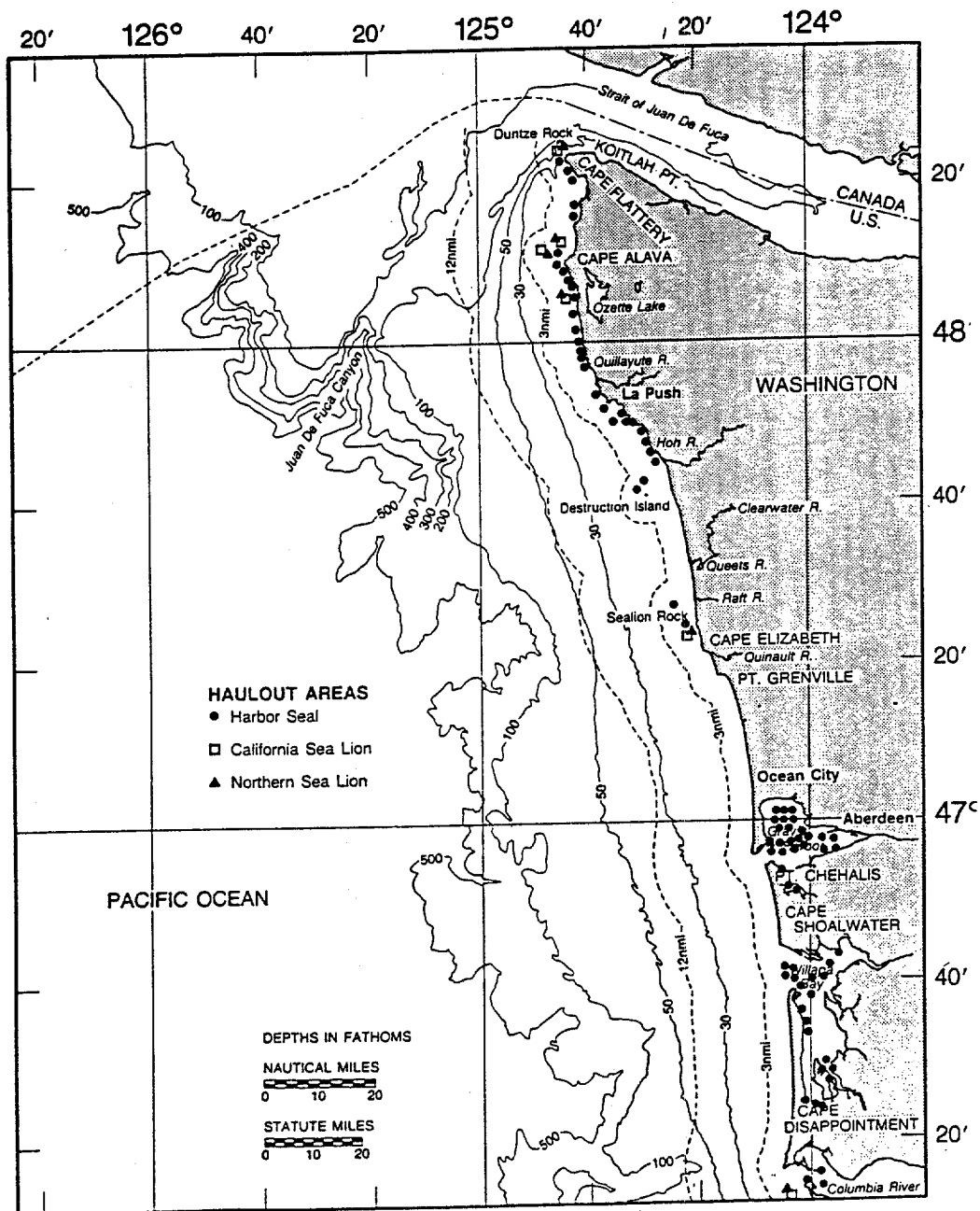


Figure 37. Distribution of Harbor Seal and Sealion Haulout Sites Along the Washington Coast (S. Jeffries, WDW in Strickland and Chasan, 1989).

structures, shallow bays, and tidal flats near abundant food sources. The current harbor seal population in Washington is estimated to be approximately 32,688 animals (Huber *et al.*, 1993), with approximately 2,200 seals occurring from Point Grenville to Cape Flattery (Speich and Whal, 1989).

Both California sea lions and northern sea lions are present on the Washington outer coast. Sea lions use open water for feeding, and nearshore islands, reefs, and rocks for hauling out. California sea lions breed on islands off the coast of California and Mexico. After breeding, many adult and sub-adult males migrate northward into British Columbia. They are found in Washington waters from August through May. As many as 4,000-5,000 individuals have been estimated to migrate through the vicinity of Sealion Rock (Bigg, 1985 in Speich *et al.*, 1987). California sea lions prefer isolated rocky areas of coarse sand beaches free from human interference as haulout sites.

Northern (Stellar) sea lion population declines have been documented in the core of their range in Alaska resulting in the species being listed as threatened under the Endangered Species Act. However, numbers of Stellar sea lions have remained stable in British Columbia, Washington and Oregon. The range of the northern sea lion extends around the Pacific rim from Hokkaido, Japan, to the Channel Islands off the coast of southern California. The centers of abundance and distribution are the Gulf of Alaska and Aleutian Islands, respectively (Loughlin *et al.*, 1987). Loughlin, Perlov, and Vladimirov (1992) estimated the current Stellar sea lion population range-wide at 39-48 percent of the population estimated by Kenyon and Rice in 1961. The NMFS has placed the northern sea lion on the Federal list of threatened species due to massive population declines (63% loss between 1985-1989) in areas where they are most abundant such as the Aleutian Islands and the Gulf of Alaska (NMFS, 1992).

While there are no known breeding areas in Washington, northern sea lions are found along the coast throughout the year. Primary haulout sites are located along the northern coast, especially near Flattery Rocks, Cape Alava, and Split Rock. Northern sea lion populations in Washington were estimated during the 1970's to be about 450 in winter and 600 in summer (Strickland and Chasan, 1989).

Northern fur seals breed primarily on the Pribilof Islands in the Bering Sea. They migrate southward into the eastern North Pacific Ocean during the late fall and early winter, reaching peak numbers of 86,000 off Washington in April (Antonelis and Perez, 1984). Northward migration begins by early spring with the fur seals mostly absent from the area from July through December. Northern fur seals prefer the open waters of the continental shelf and rarely come within 8 km of land.

The northern elephant seal is the largest of the pinnipeds in the North Pacific. They breed between January and March on island from central California south to Baja California. After the breeding season, they move into coastal and offshore waters with males traveling as far north as southeast Alaska. Elephant seals can be seen year-round off Washington though sightings are most common in the spring. They usually prefer waters well offshore but have been sighted on Tatoosh Island (Calambokidis et al., 1987) and are reported to occur in inland waters of Washington (Everitt et al., 1979, 1980).

Sea otters along the Washington coast once ranged from the mouth of the Columbia River to Point Grenville, with fewer numbers found north to Cape Flattery, Neah Bay, and east into the Strait of Juan De Fuca. Commercial hunting for its valuable pelt had eliminated the species from Washington by the early 1900's. The last known "resident" sea otters in Washington were taken in Willapa Bay in 1910 (Scheffer, 1940). A total of 59 otters transplanted from Alaska were released at Point Grenville and La Push in 1969 and 1970, forming the basis for the present population estimated to be 300 individuals in 1992 (Bowlby, 1992). Sea otters currently range along 70 km of the coast from Destruction Island north to Point of the Arches (Figure 38). They prefer rocky habitats with extensive kelp beds common to the northern portion of the sanctuary study area, and usually feed within one mile of shore in waters less than 20m deep. The population undergoes seasonal shifts in location. The Cape Alava area is used all year with higher numbers there in winter and early spring. By summer some of the population has shifted south to the area of Cape Johnson (just north of La Push). These otters eventually return north, and by September the main population is back at Cape Alava. This area is probably preferred for winter habitat because of the extensive Macrocystis kelp beds, and the protection offered by Ozette and Bodeliteh Islands. The sea otter is on the Washington State endangered species list.

River otters are land mammals usually associated with freshwater rivers and lakes, but have adapted to the marine environment. They are often mistaken for sea otters and are found in marine/estuarine areas along the outer coast, especially in the vicinity of Cape Alava. Their diet includes marine prey such as fishes, crabs, mussels, oysters, barnacles, and sea stars. Other land mammals such as black bear, deer, and raccoons prowl the intertidal area for food.

An analysis of the distribution of marine mammals among the seven subareas indicates that areas 1, 2 and 5 stand out as most significant to the overall assemblage of marine mammals. These are the areas that are furthest offshore. Also, the sanctuary study area provides particularly significant habitat for seven marine mammals: the harbor seal, harbor porpoise, killer whale,

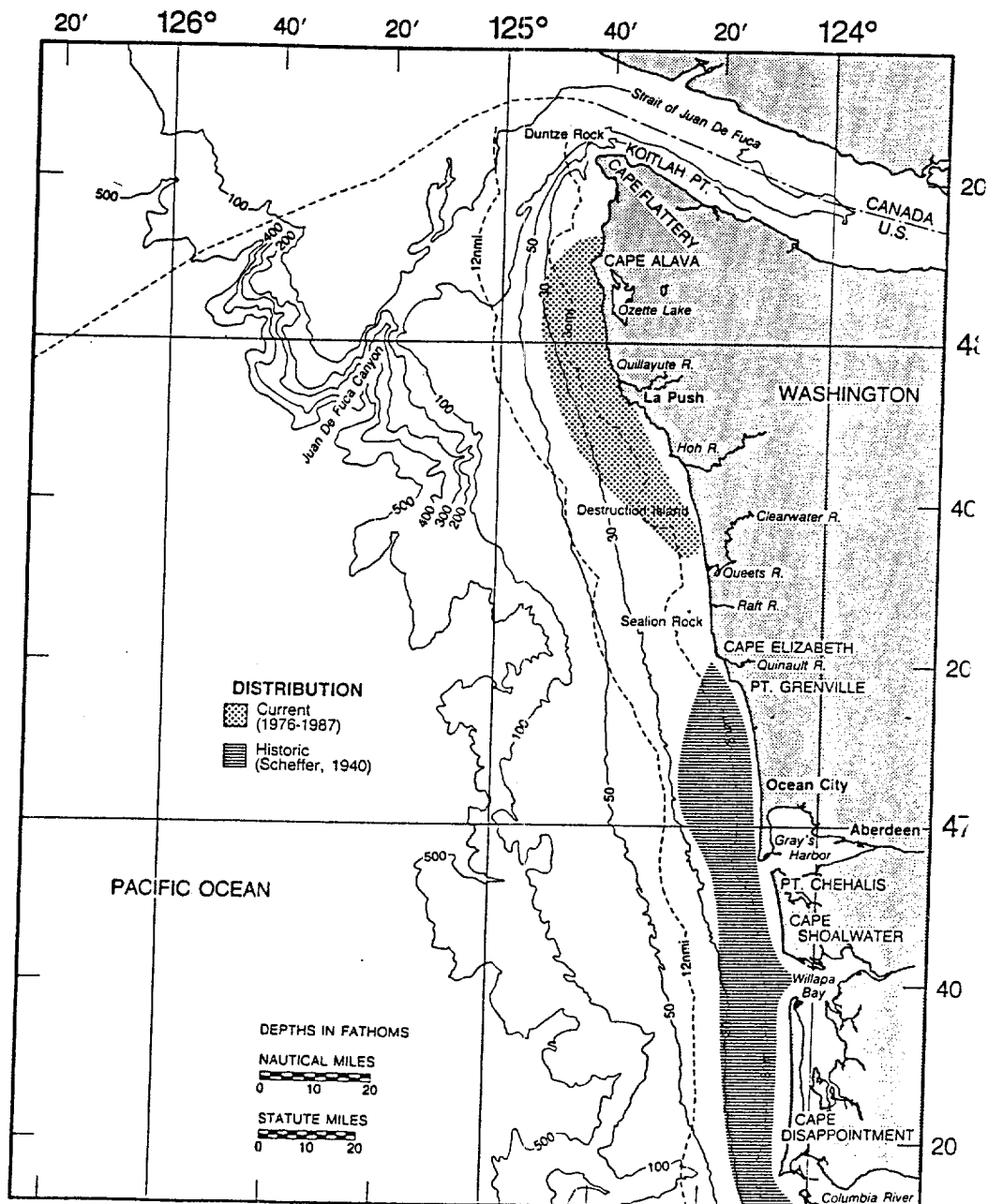


Figure 38. Historic and Current Distribution of Sea Otters in Washington State (Strickland and Chasan, 1989).

Pacific white-side dolphin, gray whale, fin whale, and Risso's dolphin. For these seven mammal species, the areas nearest to the coast are significant to the harbor seal, harbor porpoise, killer whale, and gray whale, while the other three species depend on the outer shelf areas. Most of the region under consideration for sanctuary status occurs within migration pathways for several species. It is noteworthy that a major adult summer area for the endangered fin whale occurs along the continental slope seaward of the study area (SAB, 1988).

#### G. Sea Turtles

Studies of sea turtle distribution and abundance in the North Pacific Ocean are progressing, but there are many gaps in the knowledge base. Pacific sea turtles nest on beaches in the tropics and subtropics but have been sighted in the eastern North Pacific as far north as the Gulf of Alaska. Many species are highly mobile and may migrate thousands of miles. Most sea turtle information to-date has been collected at nesting sites. Observation and study becomes much more difficult once the turtles leave the shore. Subsequently, very little is known about the life stages between hatchling and adult. Some evidence suggests that post-hatchling and juvenile life stages occupy a poorly known pelagic habitat (Eckert, 1991).

Sea turtles live very long lives. It is believed that some species (e.g. loggerhead and hawksbill) require as many as 30 years or more to reach sexual maturity. Each individual female will typically return to the same beach for each nesting cycle. In addition, nesting usually occurs at multiple-year intervals (often 2-4 years). Turtles are most vulnerable to predators (e.g. humans, birds, crabs, mammals, fish, sharks, and reptiles) while in the egg and hatchling stages. Adult leatherbacks are preyed upon by killer whales in Mexican waters and presumably larger sharks. Hard shell sea turtles are believed to have decreasing mortality rates as they mature to adulthood due to size and armoring. (Eckert, 1991)

Sea turtles frequent the Washington coast but have never been found in the inland waters of the state. However, there was an unconfirmed reported sighting of a live sea turtle from Skagit Bay in August, 1992. The following description of sea turtle status in Washington waters is the best and most concise summary found among the available scientific literature:

Three state and federally listed species of sea turtles - loggerhead, leatherback and green - visit Washington waters, but rarely come ashore unless sick or injured. The leatherback is classified as an endangered species [Federal and state lists] and the loggerhead and green sea turtles are threatened species [Federal and state lists].

The most common sea turtle off Washington's coast is the leatherback, a black flexible-shelled turtle that can be six feet in shell length. Their primary food is jellyfish. They are the most wide-ranging of all living reptiles and are more tolerant of cold waters than hard-shelled sea turtles. Leatherbacks nest on beaches in southern latitudes. The largest known nesting area is on the Pacific coast of Mexico. Collection of its eggs for food, primarily in the western Pacific ocean, is a major threat to this species.

The green sea turtle is the most common hard shell sea turtle found off Washington's coast. Like many other tropical species, unusual warm ocean currents off our coast [particularly El Nino events] can bring the green sea turtle to our shores. Two live green sea turtles [were] found beached on the Washington coast during winter 1989-90... [Green sea turtles have been sighted as far north as Admiralty Island, Alaska.] This species nests on many islands in the tropical Pacific Ocean, including the Hawaiian and Marshall Islands, and the Phillipines. While their eggs have long provided for subsistence harvest, recently developed markets for skin and other products from the turtles has led to near collapse of some populations.

The loggerhead sea turtle is rare in temperate waters. Washington is as far north as this species has ever been found. A juvenile loggerhead was found on the beach at Ocean Shores in December 1990... Adults grow to four feet in length. They feed on marine animals such as crabs, snails, clams, and shrimp. The loggerhead nests on beaches in the Pacific Ocean around Australia, China, and Japan. Recently, thousands [ $>100,000$ ] of juveniles were discovered feeding on red crabs off Baja Mexico. The causes of recently observed declines at Pacific Ocean nesting beaches are not known.

The first Olive Ridley sea turtle ever found in Washington washed ashore near Copalis in November 1989. This carnivorous, hard-shelled sea turtle is abundant in the tropical Pacific Ocean and nests in Mexico, Costa Rica, Malaysia, and Thailand. Synchronized nesting may occur and can involve as many as 150,000 females. Some populations are on the verge of collapse, however, because of massive egg collecting (WDW, 1991b).

Aerial surveys of California, Oregon, and Washington waters have shown that most leatherbacks occur in slope waters, while fewer occur over the continental shelf. Adult green turtles are benthic herbivores, subsisting mainly on algae and sea grasses. Their diet would seem to restrict them to the photic zones surrounding islands and continents. Loggerheads inhabit continental shelves, bays, estuaries and lagoons. They are generally found feeding on benthic invertebrates in hard bottom

habitats. Olive Ridleys are widely distributed in the Pacific and appear in both coastal and pelagic habitats. Foraging appears confined mainly to tropical neritic waters, where individuals may dive as deep as 300 meters to feed on benthic crustaceans. (Eckert, 1991).

Duxbury (1992) asserts that humans pose the greatest threat to the survival of all sea turtles. Turtle eggs, meat, skins, and shells are prized throughout the Pacific, and exploitation has been severe in some areas. Habitat loss at nesting areas has also contributed to the decline of some sea turtle populations. However, turtles have never been an important component of local economies or cultures on the western seaboard of the United States (Eckert, 1991).

Human activities that could possibly impact sea turtles in Washington waters are fishing operations and oil spills. Since sea turtles frequent the Washington coast in dispersed, low numbers, incidental catch by coastal fisheries poses a negligible threat to Pacific species. A report by the NMFS (1990) states that, "The incidental involvement of sea turtles with commercial fisheries on the west coast is rare... No turtles have been reported taken in groundfish fisheries [of Washington, Oregon, and California]" (NMFS Section 7 Biological Opinion, 1990). Leatherback turtles have been taken in salmon seines in Alaska and experimental shark drift gillnets (1986-88) off California, Oregon and Washington; however, federal permits for the shark drift gillnet operations were not renewed after 1988. Sea turtles have been a frequent bycatch in high-seas driftnets, but United Nations action ended this fishery on January 1, 1993.

The effects of oil spills on sea turtles is unclear due to lack of research. Because the migration range of adult turtles is wide, it is unusual to have large numbers of turtles directly impacted by an oil spill. Spill related turtle impacts are mostly anecdotal and poorly documented as to cause of death. Laboratory studies, however, have indicated that oil contamination of eggs, hatchlings and juveniles may cause morphological, physiological and behavioral alterations or death in young sea turtles. Pelagic tar also seems to be harmful to sea turtles, since it can seal the mouths and nostrils of the animals. A review of world-wide sea turtle decline by the National Research Council (1990) presents no conclusive data regarding oil effects on sea turtles. The report states that additional information is needed on the reaction of sea turtles to petroleum ingestion, fouling, and toxicity (NRC, 1990; (NMFS, 1991).

### 3. Cultural and Historical Resources

The earliest record of human life on the coast of Washington is that of the coastal Indians (WDOE, 1986). Five native American cultures occupied the coastal areas within the proposed

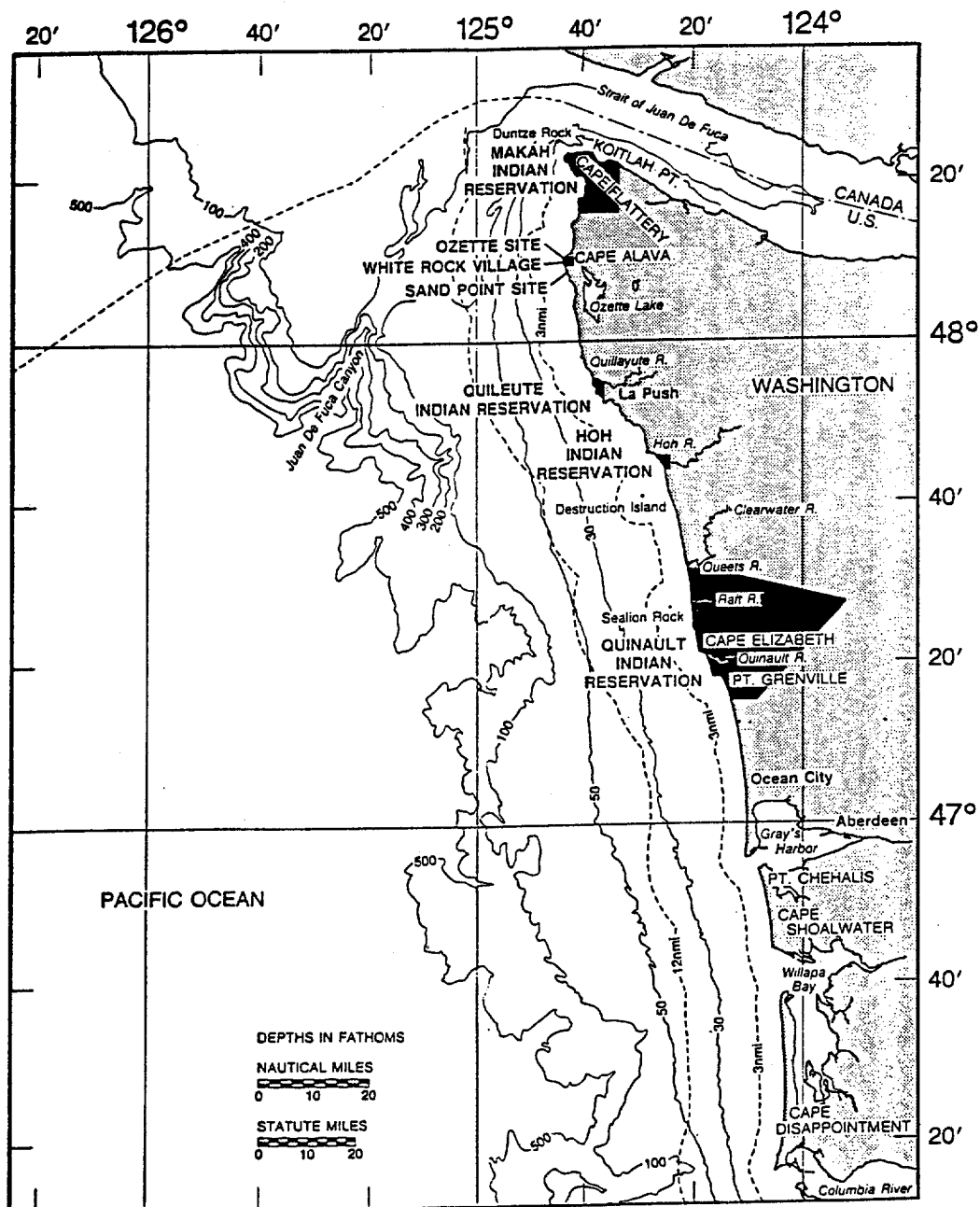
sanctuary: the Makah, Quileute, Hoh, Queets, and Quinault (Figure 39). An archaeological survey conducted by the University of Washington in 1955 found a total of 19 sites in the coastal area of Olympic National Park (National Park Service, 1976). A recent inventory re-located 10 shell midden sites and 2 rock art sites (Wessen, 1989). The most important site is the Ozette Archaeological Site located on Cape Alava (listed in the National Register of Historic Places). Here, the Ozette Indian Nation occupied the Ozette village into the early 1900's. Shell midden deposits have yielded bones and artifacts as old as 2,000 years along with protohistoric houses that were buried and preserved by a mudslide (Huelsenbeck, 1983). Other primary sites include the Kahii Village Site at Toileak Point south of La Push, White Rock Village located about two miles south of Cape Alava, and the Sand Point site about three miles south of Cape Alava. There may be more undiscovered archaeological and traditional cultural properties in the area. Petroglyphs of unknown age are found at Wedding Rock, about 1.3 miles south of Cape Alava (listed in National Register of Historic Places).

There are two small memorials to the crews and passengers that perished in shipwrecks along the coast. The Norwegian Memorial, found 8 miles south of Sand Point, commemorates the 18 people that died in the wreck of the Prince Arthur in 1903. The Chilean Memorial, 4 miles to the south, commemorates the 20 people lost in the wreck of the P.J. Pirrie in 1920. Both memorials are in the form of small stones with the names of the victims, and are located just back from the beach in dense brush. Other recorded shipwrecks include 9 ships wrecked between Quillayute Rocks and Cape Alava, 5 at Destruction Island, and 4 in the vicinity of Hoh Head (Malin, 1984).

### C. Human Activities

#### 1. Commercial Fishing and Aquaculture

Washington's local water fleet is typified by small-scale operations with relatively small earnings per vessel. In 1987, ex-vessel revenues per boat averaged between \$54,000 and \$69,000. Total employment by this fleet is estimated to be approximately 7,000 with an additional 500-700 fishermen associated with other fleet components and tribal fisheries. The number of vessels in the local water fisheries has been declining. Since 1975, troll permits issued in the salmon fishery have declined by over 2,000 (NRC, 1988). These permits cannot be reinstated under the limited entry system established in the 1970's. In 1987, there were 3,525 boats participating in Washington's local fishery (NRC, 1988). Over 350 boats have withdrawn from the fishery between 1985-1987 due to the withdrawal of approximately 372 salmon troll permits.



**Figure 39.** Indian Reservations and Associated Archeological sites along the Olympic coast (Illustrations, Unlimited, 1991).

The fishery resources harvested by Washington's local water fleet include five species of salmon (chinook, coho, sockeye, chum, pink), bottomfish (including halibut, rockfish, cod, flatfish, sablefish, hake, green and white sturgeon), and shellfish (Dungeness crab, pink shrimp, clams and oysters). Aquaculture and mariculture operations, conducted primarily in Puget Sound and in estuarine areas off the coast contribute significantly to the local waters harvest (NRC, 1988).

Fisheries for salmon which contribute the bulk of revenues for the local fleet, are influenced by the cyclical abundance of approximately 60 distinct stocks. Many specific salmon fisheries are controlled on the basis of "weak stock management" in which harvest limits are set to safeguard against over-harvest of the least viable individual stocks. In the ocean troll fishery for coho and chinook salmon, occurring in the oceanic waters of the study area, this management regime has put severe constraints on harvest levels. Washington's gillnet and seine salmon fisheries, which occur in the Strait of Juan de Fuca and in the river mouths entering the study area, are still highly dependent on sockeye salmon from Canada's Fraser River. These Fraser River sockeye runs are based on a four-year cycle (NRC, 1988).

Groundfish include bottomfish which are caught mainly on or near the seafloor, and other marine species that are caught at mid-water. The harvest of groundfish species is comprised of over 35 varieties of rockfish, flatfish and roundfish. The primary species caught include many species of rockfish (Pacific ocean perch, widow rockfish, yellowtail rockfish, black rockfish), flatfish (English sole, Dover sole, arrowtooth flounder, Pacific halibut), and roundfish (Pacific cod, Pacific hake, lingcod, and sablefish). The commercial coastal catch of groundfish has risen from approximately 18 million pounds in 1970 to 42.1 million pounds in 1991 (PacFIN, 1992). Groundfish are caught by bottom (otter) trawling, midwater trawling, longlining or setlining, bottom trolling, fixed pots, and hand-line jigging. Fishing may take place in depths ranging from 10 fathoms out to the canyons at the edge of the continental shelf, and beyond. Roundfish dominate the landed catch in this fishery. In recent decline are the abundance and mean size of sablefish (black cod) (Parks and Shaw, 1987). The most important commercial rockfish in the eastern Pacific is the Pacific ocean perch. Because stocks of this species have become severely depleted, the PFMC has adopted a management strategy to rebuild them to previous levels (Ito *et al.*, 1987). Commercial interest has recently been shown in the thresher shark which migrates into Washington coastal waters in the spring. Both domestic and joint-venture catches of Pacific hake (marketed as whiting) have increased since the early 1980's and its stocks are currently fully utilized (Hollowed *et al.*, 1988; June, 1993). Surf smelt are recreationally dipped as far north as the mouth of the Quillayute River.

Dungeness crab and pink shrimp stocks have historically been quite cyclical in nature. Razor clam stocks have declined dramatically in recent years due to the outbreak of the NIX virus, gill parasites and overharvesting. Only a small Indian fishery and recreational fishery exist for razor clams.

The amount and value of the local catch is of great importance to the state's economy. In 1992, the ex-vessel value of the commercial landings approximated \$152 million, up from the 1981-1985 average of \$92.8 million (Table 4) (NRC, 1986; NMFS, 1992a). The salmon fishery was once the largest and most valuable fishery in the coastal waters. The salmon catch is now exceeded in tonnage by the groundfish catch; however, the yearly harvest of salmon is nearly three times more valuable at the fisherman level than the groundfish or shellfish catch (Natural Resources Consultants, 1986; June, 1993). The values and volumes for commercial harvests of selected species in Washington State, and in the sanctuary study area are shown in Appendix C (Tables 1 and 2).

The salmon and groundfish species in the study area are managed under Federal Fishery Management Plans (FMP's) drafted by the PFMC. In the FMP's, the PFMC establishes catch limits for groundfish and specifies the duration of the fishing season and catch and size limits for salmon. Commercial and recreational fishing gear restrictions are specified for both the groundfish and salmon fisheries. The Magnuson Fishery Conservation and Management Act (MFCMA) provides for enforcement of FMP's prepared by the PFMC and approved by the Secretary of Commerce after review by the NMFS.

Fisheries for Pacific halibut are regulated by the NMFS under a treaty with Canada. The Dungeness crab and pink shrimp fisheries are managed by the Washington Department of Fisheries. The Pacific States Marine Fisheries Commission is currently developing interstate (Washington, Oregon, and California) plans for the crab and shrimp fisheries under the Inter-jurisdictional Fisheries Act (IJFA). NMFS is funding portions of the state monitoring and management of these fisheries.

The tribes are co-managers of the fisheries resources and are involved in plan development, monitoring, licensing and enforcement. The tribes are guaranteed a portion of the salmon and steelhead catch pursuant to the Boldt Decision of 1974 which allocates a portion of the anadromous fish among tribal and non-tribal fishers by region of origin. For the purposes of fish stock allocation and record keeping, local or coastal commercial fisheries are classified as the non-treaty commercial fishery and the treaty fishery.

Table 4. Volume and Value of Washington State's Local Water Catch by Fishery Type (1981-1985 average; 1990)

FISHERY	POUNDS (Millions of lbs)		VALUE (Millions of \$)	
	1981-85 (avg)	1992	1981-85 (avg)	1992
Groundfish	78.2	33.6	13.9	10.8
Salmon	40.6	45.1	40.0	39.8
Shellfish	16.6	45.5	10.6	57.7

Source: Data supplied by Washington Department of Fisheries, 1993 and PacFin, 1992, Report #002.

(a) Commercial Non-Treaty Fishery

Salmon, bottomfish, crab, shrimp, oyster, and clams form the basis of the coastal non-treaty commercial fishery (Figure 40). Salmon caught off the Washington outer coast must be caught by the trolling method. Other methods, such as purse seines, drift nets, or drift gillnets, are prohibited in ocean waters. Commercial trollers mainly catch coho, pink and chinook salmon. Since 1976, coastal trollers' salmon catch has fallen. For example, average landings of chinook salmon declined from 262,000 fish in 1971-1975 to 183,000 fish in 1976-1980; only 54,600 were caught in 1987 (PFMC, 1988). Most of the trolling for chinook and coho salmon is centered around the Grays Harbor area. Pink salmon, which are harvested only in odd-numbered years, are taken primarily off the north coast from Cape Flattery to Quillayute.

The major commercially harvested shellfish in the sanctuary study area and adjacent estuaries include Dungeness crabs, pink shrimp, Pacific oysters, and several species of clams. Although their abundance varies over and 8 to 10 year period, Dungeness crabs are the most important commercial shellfish. Pink shrimp are also subject to large variations in abundance. Production areas for shrimp harvesting are found from Cape Elizabeth north to Cape Flattery. The razor clam population, depleted in recent years by the NIX virus, gill parasites, and perhaps over harvesting, only supports a small restaurant trade and recreational fishery. The most recent commercial harvest occurred at offshore spits in Willapa Bay and the Quinault Indian Reservation (Strickland and Chasan, 1989). There is also a coastal commercial sea urchin harvest.

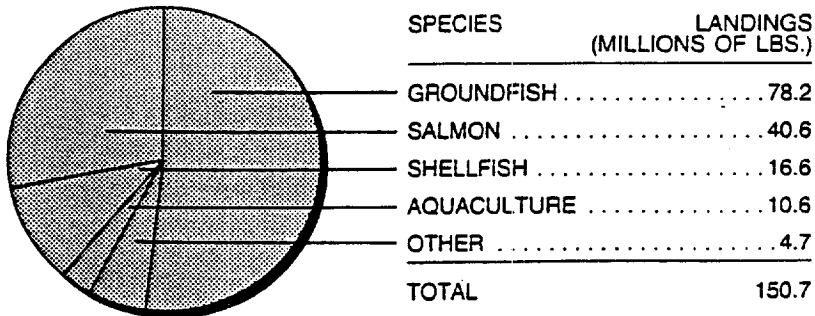
(b) Treaty Fisheries

The entire study area north of Willapa Bay can be considered a usual and accustomed fishing area for treaty tribes. Salmon and steelhead trout are the most important fishery resources available to the coastal tribes. Salmon and steelhead trout are harvested by either gillnets or troll gear. The treaty ocean troll fishery operates throughout the summer. The fishing activity is centered around the areas of Grays Harbor, Quillayute and Cape Flattery. Coho, chinook, and pink salmon are the main species taken by this fishery. The Makah Tribe conducts a marine gillnet fishery along the shore near Cape Flattery and in the Strait of Juan de Fuca for chinook and sockeye salmon. In-river treaty gillnet fisheries harvest coho and chinook salmon in the Queets, Hoh, and Quillayute Rivers; and chum, coho, sockeye, and chinook salmon in the Quinault and Ozette Rivers. In addition, treaty fisheries take steelhead trout in all the major rivers of the Olympic Peninsula.

The coastal tribes, Makah, Quileute, Hoh, and Quinault, participate in a variety of groundfish fisheries. Rockfish,

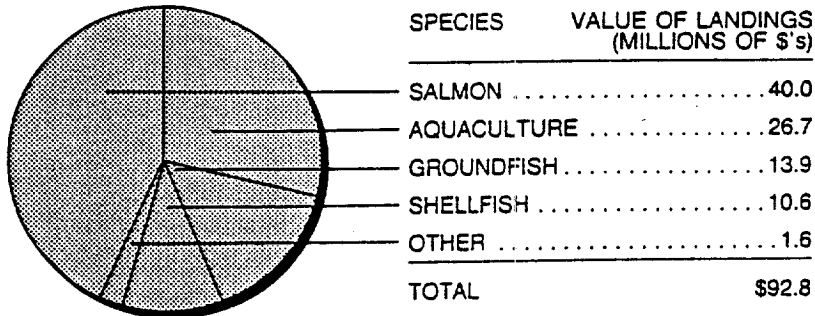
### The Harvest

Volume of Washington's Local Water Catch by Fishery Type  
(1981-1985 Annual Average)



### Value to Harvesters

Ex-Vessel Value of Washington's Local Water Catch by Fishery Type  
(1981-1985 Annual Average)



### Value of Products

Wholesale Value of Products Processed from  
Washington's Local Water Catch by Fishery Type  
(1981-1985 Annual Average)

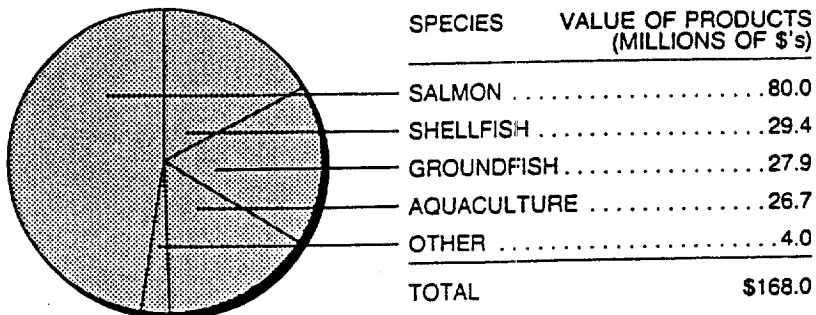


Figure 40. Commercial and Recreational Fishing Areas (Strickland and Chasan, 1989; WDF, 1992).

sablefish and Pacific halibut are the targeted species and are taken by longline and handline gear. These fisheries generally occur in the fall and spring and are centered off the north coast of the Olympic Peninsula. The coastal tribes have recognized treaty rights for halibut, and since 1986 the tribes have received a direct halibut allocation from the International Pacific Halibut Commission. In addition, the Makah and Quileute tribes receive a set aside of sablefish from the PPMC.

The coastal tribes conduct a variety of fisheries in the nearshore area. Sea urchin, mussels, ocean clams, gooseneck barnacles, Dungeness crab, salmon, steelhead, rockfishes, cod, and smelt are harvested for subsistence and ceremonial purposes by the various tribes. The Quinault Tribe harvests razor clam for commercial purposes from beaches within their reservation. The Quileute Tribe conducts a small commercial fishery for smelt harvested from within the estuary reaches of the Quillayute River.

#### (c) Aquaculture and Coastal Hatcheries

Aquaculture and hatchery operations in areas adjacent to the sanctuary study area produce salmon, oysters, mussels, and clams for commercial purposes or for augmenting natural stocks. The importance of fish and shellfish farming to Washington's seafood industry is shown by the fact that fewer than 200 oyster, salmon, and clam farms produce 16 percent of the wholesale value of the state's local seafood harvest (Natural Resources Consultants, 1986). Most of the aquaculture operations are in Puget Sound or Grays Harbor and Willapa Harbor. Coastal hatchery facilities closest to the sanctuary study area include four tribal salmon hatcheries located on the Makah, Quileute, Hoh, and Quinault Reservations. These hatcheries released approximately 8.5 million fish in 1986, including 2 million steelhead trout (Butts, 1988). The WDF operates the Soleduck, Bear Springs, Kalawa River Ponds, and Snyder Creek (in cooperation with a steelhead guide operation) hatcheries in the Quillayute drainage system. WDF also operates the Canyon Springs acclimation pond on the Hoh River in cooperation with the Hoh Tribe, and the Shale Creek hatchery on the Queets River. A proposed WDF facility on the Mathaney River is expected to be completed within a year. The USFWS and Quinault Tribe operate a facility on Cook Creek.

## 2. Oil and Gas Activities

The State of Washington and the Federal government have both conducted oil and gas lease sales in Washington's offshore waters. The state conducted a series of lease sales in the 1960's in state waters in the vicinity of Grays Harbor. Union Oil Company drilled three exploratory wells several miles west of Ocean Shores. Only one well was successfully drilled, but no commercial quantities of oil or gas were found. The Federal

government conducted a lease sale in 1964 (Lease Sale P-2) off Washington and Oregon. Forty seven of the 196 tracts offered for lease were located off Washington. Only 27 of these tracts were actually leased. The highest bid off Washington was \$1,785,888 (\$310.05/acre) for a tract in the Copalis Beach area between Gray's Harbor and Willapa Bay. Four wells (three original and one redrill) were drilled off the Washington coast from 1966 to 1967: 1) nine miles west of Destruction Island; 2) nine miles west of Westport; and, 3) nine miles west of the northern entrance to Willapa Bay. While oil and gas were found in two of the wells (near Westport and Willapa Bay), quantities were not sufficient for commercial production.

Since the early 1900's, onshore exploratory wells have been drilled along the Washington coast. The discovery of a natural oil seep in the vicinity of Hoh Head at Oil City, just north of the mouth of the Hoh River, led to several attempts at drilling for oil. An attempt in 1913 was abandoned because commercial quantities were not found. In 1936, drilling in the same area led to the discovery of Washington's first oil well that went into production. Production could not be sustained and the site was abandoned. Currently, there is no onshore production of oil or gas in the State of Washington.

MMS, within the U.S. Department of the Interior, is the Federal agency with authority over all minerals development on the OCS outside of the three-mile limit of state jurisdiction. MMS is responsible for preparing and implementing 5-year plans which identify the federal waters to be opened for offshore oil and gas leasing.

MMS's current 5-year plan is entitled Outer Continental Shelf Natural Gas and Oil Resource Management Comprehensive Program and covers the years from 1992-1997. According to the plan, Washington and Oregon are not scheduled for any lease sales and will not be until after the year 2000. However, before any leasing activities can take place, a series of environmental studies must be preformed to determine whether or not oil and gas development can take place in an environmentally sound manner. This position is based on Federal executive policy developed in 1990 which canceled a number of lease sales around the country, including Lease-Sale 132 (Washington/Oregon Planning Area) (Figure 41). Figures 42 show "highlighted areas" which correspond to areas that the Governors of Washington and Oregon requested be deleted from the former Lease Sale #132; and areas within the Oregon/Washington planning area, referred to as "subarea deferrals", that MMS has deleted from sale #132. Leasing and exploration for oil and gas is not permitted in Washington state waters; Washington HB 2242 establishes a moratorium on oil and gas exploration and development in state waters until 1995.

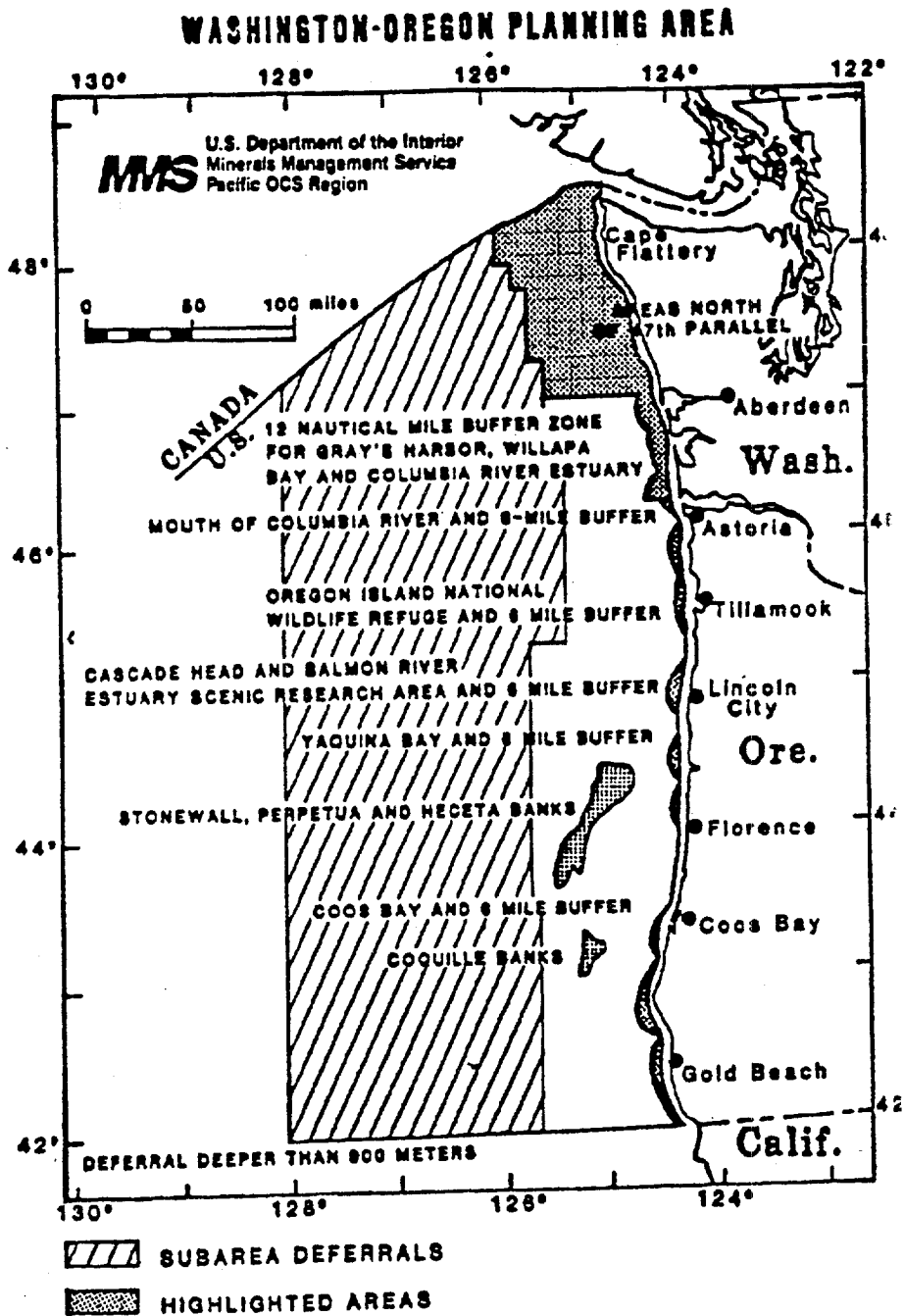


Figure 41. Washington/Oregon Planning Area.

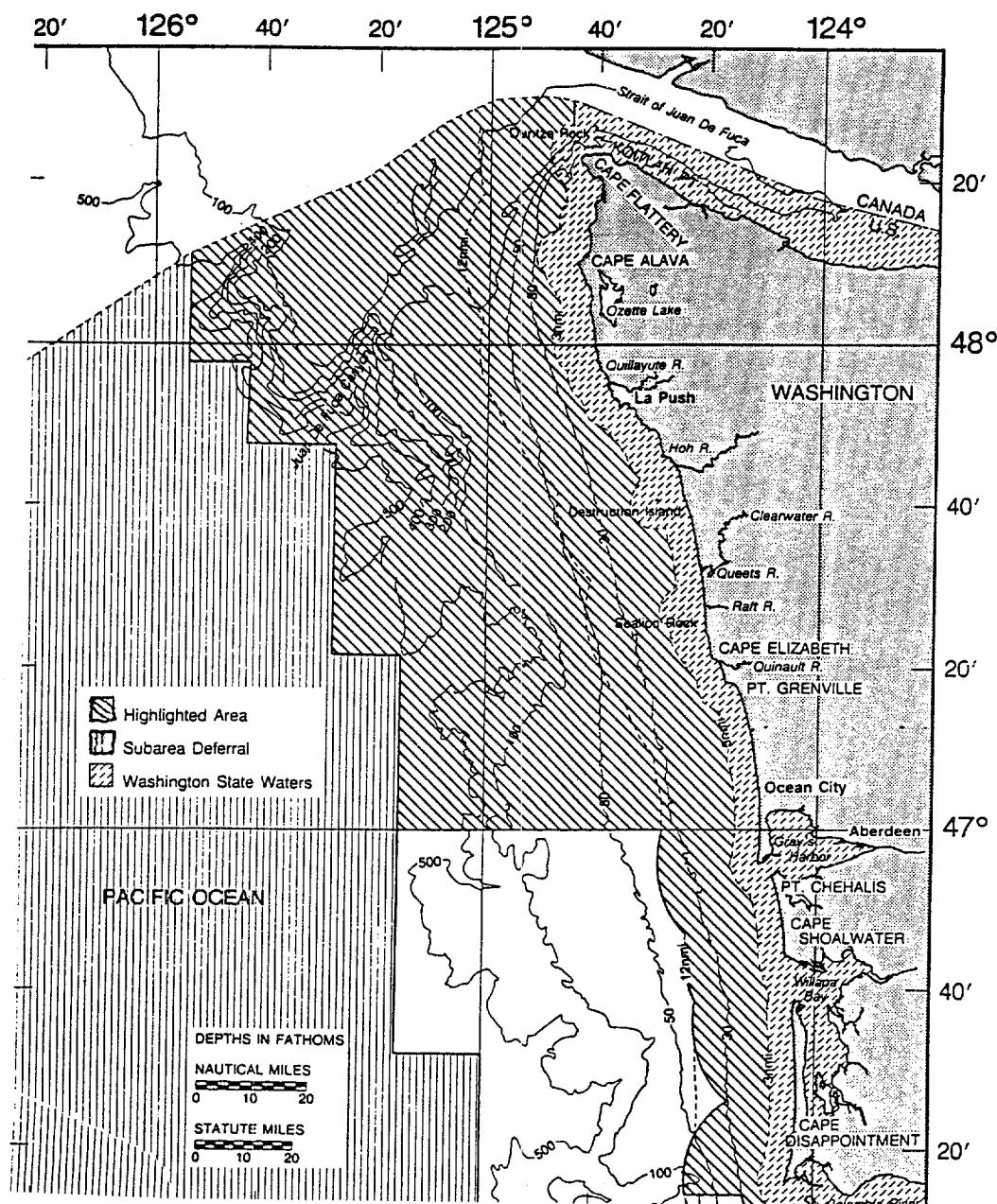


Figure 42. MMS Planning Area for Lease Sale #132 off Washington (Strickland and Chasan, 1989).

MMS has evaluated the oil and gas potential of the study area for the proposed sanctuary. By first making an assumption that past geologic conditions were conducive to the formation and entrapment of oil and gas, it is then possible to evaluate existing seismic data to estimate the location and volume of subsurface sedimentary structures that would contain the oil and gas reserves. Using the limited data available, MMS has estimated that production resulting from the former Lease Sale #132 would total 58 million barrels of oil and 1.0 trillion cubic feet of gas over a 35 year period. The entire sanctuary study area (i.e., the entire continental shelf off Washington) would include 20% of the total estimated reserves of the Lease Sale 132 area (MMS, 1990a). Of that 20%, 15% would be located in the area south of Copalis National Wildlife Refuge (which is not within the sanctuary boundary), with the remaining 5% distributed across the northern portion of the continental shelf which NOAA proposes to include within the Sanctuary (1.5% in zone 1, 2.5% in zone 2, 1.0% in zone 3). Zone 4 is entirely within Washington State waters, and is therefore not included in these estimates (Martin, 1990a).

Under the previous 5-year plan (1987-1992), the Washington and Oregon coasts had been scheduled for a lease sale in 1992. In order to resolve issues surrounding the proposed lease sale, the states of Washington and Oregon, the Northwest Indian Fisheries Commission, the Columbia River Intertribal Fish Commission and the Department of Interior established the Pacific Northwest Outer Continental Shelf OCS Task Force.

The Task Force's technical subcommittee recommended, through a resolution to the Secretary of Interior, a series of environmental studies to be completed prior to any leasing activities. The studies consist of the following:

1. Nearshore Ecosystems
2. Physical Oceanography
  - a) Estuary/coastal ocean exchange and Columbia River plume dynamics
  - b) Interannual Variability
  - c) Support of nearshore ecosystem
  - d) Cape Flattery
  - e) Heceta Bank
3. Marine Mammal/Seabirds
  - a) Supplementation of existing survey program
  - b) Seabird colony research program
  - c) Seabird life history research
  - d) Northern fur seals
  - e) Northern Sea Lion

- 4) Socioeconomic
- a) Expand scope of existing recreation and tourism survey
  - b) Coastal community impacts
  - c) Extension of basic analysis of Indian tribal dependencies on coastal resources and activities potentially affected by OCS development
  - d) Causes and consequences of cumulative ecosystem impacts relative to lease sale 132

5. Air Quality

Included in the Pacific Northwest OCS Task Force's resolution was a policy statement that precluded any leasing activities until after the above studies are completed. The Federal policy discussed above was a result of the resolution.

In 1992, the Marine Research, Protection, and Sanctuaries Act was amended to prohibit any oil and gas development activities inside the Olympic Coast Sanctuary.

B. State Waters

In 1989, the Washington State Legislature passed the Ocean Resources Management Act (ORMA). The Act placed a moratorium on the leasing of state waters for the purpose of oil and gas development. The moratorium will be reviewed during the 1995 Washington State Legislative session to determine whether it should be continued or lifted.

3. Commercial Shipping

Due to the linkages between vessel traffic patterns along the outer coast, the Strait of Juan de Fuca, and Puget Sound, this section addresses shipping issues which span all of these areas. Vessel traffic along the Washington Coast, in the Strait of Juan de Fuca and Puget Sound includes tankers transporting crude oil and refined petroleum products, bulk carriers transporting non-petroleum products, barges, ferries, fishing boats, and pleasure craft. The general profile of vessel activities in the study area are that ferries and tank barge movements, including bunkering activities, account for the greatest number of vessel transits, and tanker traffic accounts for the greatest volume of petroleum products shipped (Chadbourn and Leschine, 1989). According to the Port Needs Study conducted by the USCG (1991), by 2010 there is expected to be a 555% and 81% increase in ferry/tank barge movements and tanker traffic transits through the Strait of Juan de Fuca and Northern Puget Sound, respectively (Table 5). Washington ports and harbors serving these vessels include the Port of Willapa Harbor, Port of Grays Harbor, La Push, Neah Bay, Port Angeles, the Ports of Tacoma and Seattle, Port of Everett, Port of Anacortes, and Port of Bellingham. These ports and harbors, all which are located in

Table 5. Current and Projected Vessel Transits in the Study Area.

	Strait of Juan de Fuca			N.	Puget Sound		
	1987	2010	% change		1987	2010	% change
Passenger	3,888	4,451	14%		18,380	21,374	16%
Dry Cargo	102,808	621,309	504%		288,309	552,087	91%
Tanker	1,056	1,568	48%		1,009	1,498	48%
Dry Cargo Barge Tow	796	20,859	2520%		12,574	19,636	56%
Tanker Barge Tow	557	9,745	1649%		6,544	8,998	37%
Tug/Tow Boat	4,855	89,261	1738%		51,455	81,503	58%
Total	113,960	747,193	555%		378,271	685,096	81%

Source: United States Department of Transportation, U.S. Coast Guard, Office of Navigation Safety and Waterway Services. August, 1991. Port Needs Study (Vessel Traffic Services Benefits), Volume II: Appendices, Part 1. DOT-CG-N-01-91-1-3, Pt.1; DOT-VNTSC-CG-91-2-11, Pt. 1.

the study areas for the proposed Olympic Coast and Northwest Straits marine sanctuaries (except for the Port of Tacoma) handle predominately petroleum and wood products, and many of the ports and harbors have berths for fishing and pleasure crafts as well. While the overall density of traffic along the coast, in the Strait of Juan de Fuca, and throughout Puget Sound is low compared to other U.S. waterways, there are areas of high vessel concentration and restricted passageways which present risks of collisions and groundings. These conditions also exist outside the opening of the Strait of Juan de Fuca, beyond the jurisdiction of the Vessel Traffic Service. The sinking of the Tenyo Maru is the most recent example of such risk. Recent Federal, state, and international management regimes and legislation have been developed to address these risks while facilitating vessel traffic.

This section will discuss the: 1) routes and areas of vessel concentration; 2) nature of current and planned port-related activities; 3) economic significance of vessel traffic and port activities to Washington State; 4) vessel management regimes; and 5) vessel contingency plans and capabilities.

#### **a. Routes and Areas of Vessel Concentration**

##### **i. Tanker Traffic**

Tankers entering the Strait of Juan de Fuca or transiting along the Washington coast follow four major routes: 1) Valdez, Alaska to Washington State; 2) Valdez, Alaska to San Francisco, California and Panama; 3) the coastal tank vessel trade; and 4) foreign tanker routes (Figure 43).

Tankers transiting through the Strait of Juan de Fuca are predominately domestic vessels carrying North Slope crude oil to the refineries in Northern Puget Sound. These vessels approach the Strait of Juan de Fuca from the north remaining outside of Canada's Tanker Exclusion Zone (TEZ). The TEZ parallels the Canadian coastline at 60 nautical miles narrowing to 35 miles in the proximity of the international border (Figure 44). This zone, applicable only to U.S. vessels transiting from Valdez, Alaska to Puget Sound, has been mutually agreed upon by the American Institute of Merchant Shipping (AIMS), and the U.S. and Canadian Coast Guards. The southernmost point of the TEZ brings tankers into the Strait of Juan de Fuca on the United States side of the international boundary. Compliance with this agreement has resulted in little or no reported violations (Pokeda, 1992).

As North Slope oil supplies dwindle, the profile of tankers visiting Washington is predicted to shift to one dominated by foreign tankers. Since the Strait of Juan de Fuca includes internal waters of both the U.S. and Canada, and vessels transiting through the Strait are bound for both Canadian and

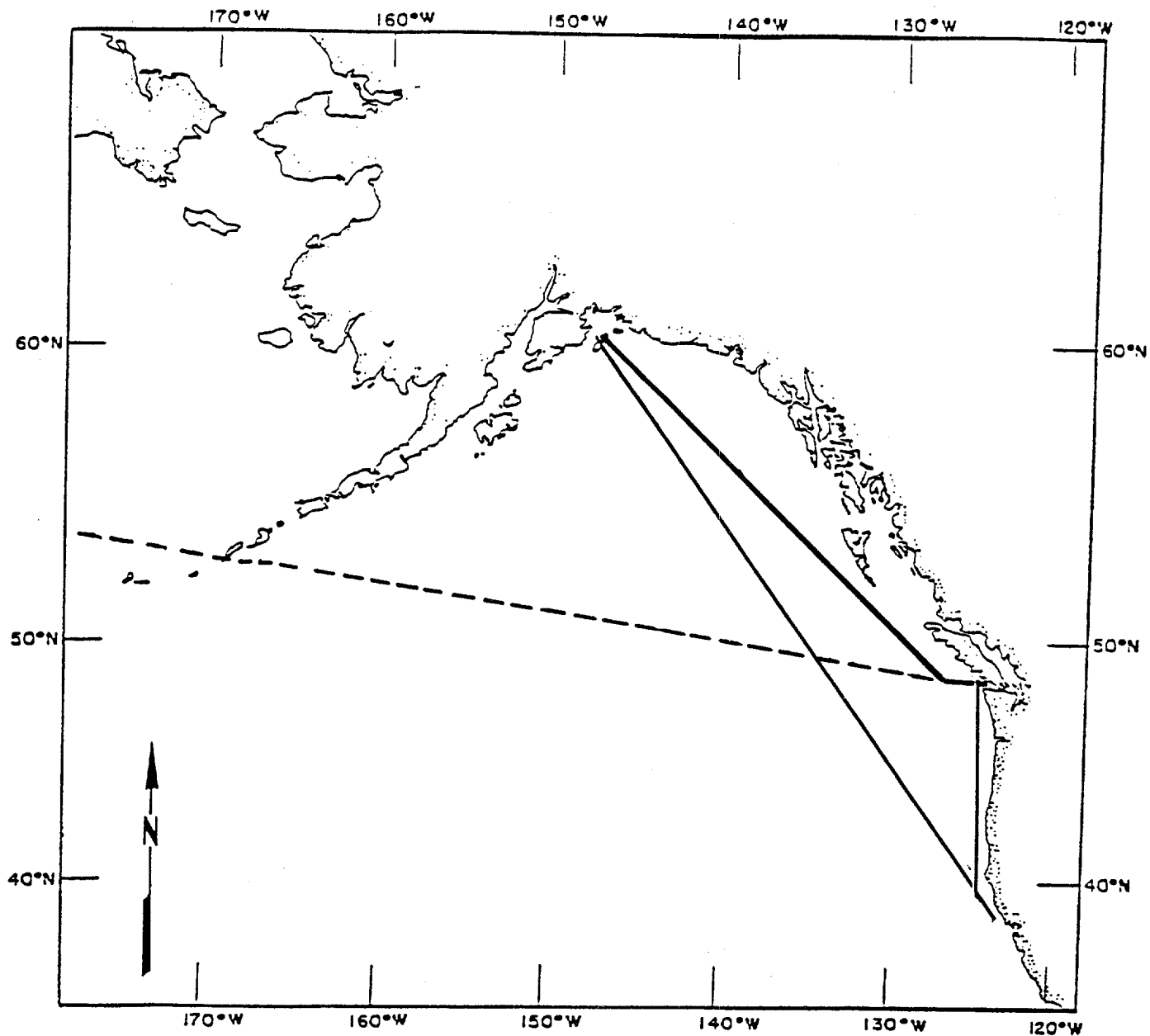


Figure 43. Tank Vessel Traffic Outer Coast (Wolferstan, W.H. Oil Tanker Traffic: Assessing the Risks for the Southern Coast of British Columbia. Victoria, B.C.: ADP Bulletin 9. July, 1981).

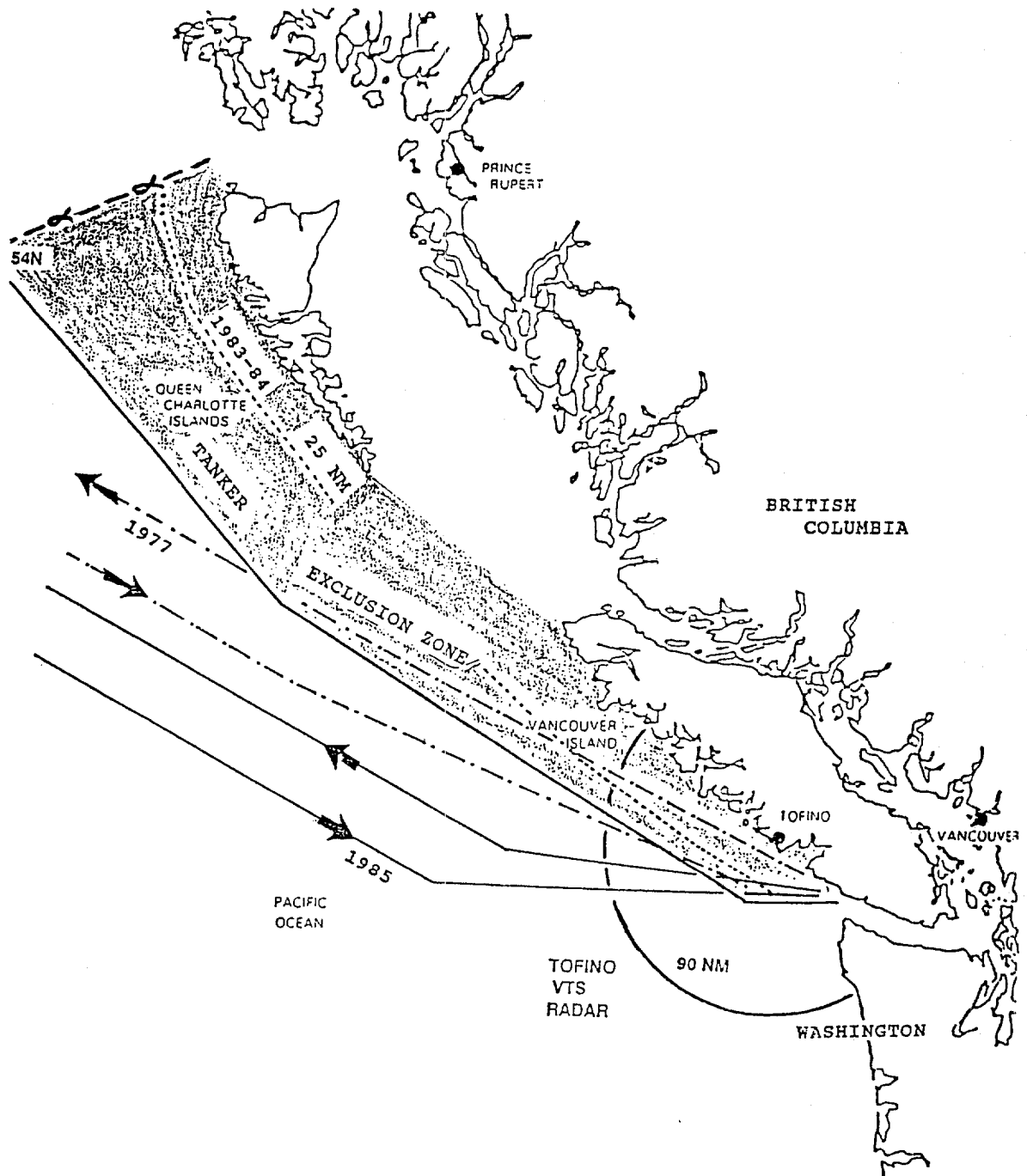


Figure 44. Tanker Exclusion Zone (Canadian Coast Guard, 1989).

U.S. ports, both countries have coordinated their environmental regulations.

Tankers transiting from Valdez, Alaska to California or Panama remain well offshore. The route is approximately 340 miles offshore of the United States/Canadian border narrowing to approximately 125 miles from the shoreline at the Washington/Oregon border (Pokeda, 1992). Pursuant to a policy of the Western States Petroleum Association (WSPA), tankers engaged in offshore coastal traffic carrying North Slope crude or other persistent oils, voluntarily remain at least 50 nautical miles off the U.S. coastline when not entering ports.

Foreign tanker routes passing through the study area include vessels inbound from the Far East and Central and South America. The former remain well offshore until their approach to the Strait, however the latter usually operate between 10 and 40 miles off the Washington coast.

Tank vessels entering and transiting Puget Sound are limited by regulation to not larger than 125,000 dead weight tons (DWT) east of Port Angeles (Title 33, CFR 161.143). The average inbound tanker holds approximately 322,000 barrels of crude oil, and the average outgoing tanker carries approximately 123,000 barrels of refined products (Chadbourne and Leschine, 1989). Tanker traffic accounts for most of the volume of petroleum shipped through the Strait of Juan de Fuca and into Puget Sound (77% volume; 17% transits), while barge traffic accounts for the greater number of transits (23% volume; 79% transits). In 1991, there was an average of 4.7 tanker transits/day (petroleum, chemical, LPG/LNG) through the Strait of Juan de Fuca (Tofino Traffic Service, 1991). There is no large seasonal variation of traffic throughout the year (Chadbourne. and Leschine. 1989).

#### ii. Barges and Tug Boats

There are innumerable tug and barge movements along the coast between Grays Harbor, Willapa Bay and Puget Sound ports. Barges are used mainly to transport lumber and wood chips from Grays Harbor and Willapa Bay, and chemicals, petroleum products and bulk cargos from the Puget Sound area. Barges operate close to the shoreline when transiting through the study area, remaining between 3 and 15 miles offshore. However, some companies require their tows stay a minimum of 20-25 miles offshore when towing loaded petroleum barges (Scalzo, 1992).

Barges are also used to transport decommissioned, defueled Naval submarine reactor plants from the Puget Sound Naval Shipyard to the Hanford Site on the Columbia River for disposal. The normal commercial shipping lanes from Puget Sound Naval Shipyard are used, via Rich Passage, past Restoration Point, northerly through Puget Sound, westerly through the Straits of

Juan de Fuca, past Cape Flattery and in a southerly direction down the Washington Coast to the mouth of the Columbia River (U.S. Department of the Navy, 1984). Barges used to transport the decommissioned reactor plants travel close to shore so that in the unlikely event that a barge carrying the reactor plants were to sink it can be easily recovered.

Extensive precautions are taken to ensure that these barge shipments are made safely. The reactor compartment packages meet stringent U.S. Nuclear Regulatory Commission and Department of Transportation regulations for transportation of radioactive material, including being able to withstand such unlikely and unrealistic accidents as a 30 foot drop onto an unyielding surface. The transport barges are used solely for these shipments and are designed to remain stable in an upright position even with any two adjacent watertight compartments flooded. The barges would remain afloat even with over half of their compartments flooded, and the reactor compartment package is welded to the barge deck so that it would remain attached even if the barge capsized. A fully capable backup tugboat and an escort vessel accompany each barge shipment. Reactor compartment shipments are not made during the winter months or during any times when unfavorable weather is forecast.

Conflicts between barge traffic and crab fishermen have resulted in a "gentleman's agreement" reached in 1971 which identifies towing lanes for tugs and barges along a major portion of the West Coast, including most of the Washington coast (NOS, 1990). The location of the lanes are determined on a yearly basis. According to the agreement, crab fishermen refrain from putting their pots in lanes designated for tugs and barges. If pots are placed in designated lanes, crabbers forfeit their right to complain if pots are destroyed by a tug or barge. In turn, towboaters agree to stay within designated lanes, as weather and ship safety allow. The agreement has saved millions of dollars for both the fishing and towing industries. An annual meeting, and publication and distribution of charts depicting the agreed upon lanes, is organized by the Northwest Towboat Association (Northwest Towboat Association, 1991). This function has been assumed by the Oregon State University, Extension Sea Grant Program.

Barges account for the greatest number of vessel transits along the Washington coast and through the Strait of Juan de Fuca and Northern Puget Sound. Barges and tug boats accounted for 33% of the petroleum shipped and 79% of transits throughout Puget Sound and along the Washington Coast to Grays Harbor and Willapa Bay in 1988. This represents approximately 8.1 (81%) of the average 10 petroleum-related transits in the Strait of Juan de Fuca and Puget Sound (Chadbourn and Leschine, 1989). The number of transits of barge-direct activity, (i.e., barges that make direct passage in and out of the Strait without significant

movement within the Sound itself) varies substantially from month-to-month in both volume and number of transits (Chadbourn and Leschine, 1989). The average volume on any barge is approximately 22,000 barrels per transit.

### iii. Foreign Product Carriers

Many of the vessels transiting the Washington coast are engaged in foreign trade. There are also many foreign flagged vessels that run coastal routes along the coasts of Washington and Oregon. The usual route for this traffic extends from Cape Flattery, Washington to Southern California and is concentrated between 3-20 miles offshore (Pokeda, 1992). These vessels are not subject to the voluntary policy of the WSPA that applies to oil tankers. However, all vessels, foreign or domestic, must comply with OMS' prevention and contingency plan regulations. Foreign vessels, while not forced to comply with some voluntary vessel regulations, are required to submit prevention and contingency plans to OMS.

## IV. Ferries

Ferry traffic is used extensively throughout the year to transport passengers and vehicles to numerous destinations throughout Puget Sound and represents the greatest source of total vessel movement in the Sound (including petroleum and non-petroleum vessels transits). According to statistics kept by VTS Seattle, approximately 73% of the nearly 600 vessel transits per day within Puget Sound and the Strait of Juan de Fuca, are ferries along scheduled routes (USCG, 1991).

Two ferries cross several times per day between Port Angeles and Victoria, B.C. Direct ferry service also exists between Seattle and Victoria. Scheduled ferry service from Anacortes westward to the San Juan Islands and to British Columbia transits Rosario Strait on a frequent basis. Another ferry route connects Kingston, on Bainbridge Island, and Edmonds and another connects Port Townsend and Whidbey Island (USCG, 1991). Other ferry routes traverse the Sound south of the boundaries suggested for the proposed Northwest Straits National Marine Sanctuary. All ferries in the Northwest Straits study area (with the exception of the Port Angeles-Victoria route which is privately owned) are operated by the Washington State Department of Transportation.

## V. Fishing Vessels

Washington's fishing vessels harvest a wide variety of fish and shellfish including bottomfish, shellfish, and five species of salmon. The fishing vessels are operated by commercial non-treaty, treaty, and recreational fishermen. Salmon landed by non-treaty commercial fishermen are harvested using the trolling method. Purse seines, drift nets and gill nets are prohibited in

ocean waters. Most trolling for chinook and coho is centered off Grays Harbor. Trolling for pink salmon (harvested in odd-numbered years) occurs off the northern Peninsula between Cape Flattery and Quillayute. A major fishing area for salmon also exists at the entrance of the Strait of Juan de Fuca on Swiftsure Bank. Particularly hazardous vessel traffic conditions exist over Swiftsure bank during periods of low visibility, when commercial vessel traffic must exercise extreme caution to avoid collision with fishing boats which tend to defy radar detection. Commercial and recreational seasons for the salmon fisheries are set between May 1 and October 31 (PFMC, 1984).

Bottomfish are harvested by bottom and midwater trawling, longlining, bottom trolling, and hand-line jigging. Fishing may take place in depths ranging from 10 fathoms out to the canyons at the edge of the continental shelf, and beyond. The Pacific coast domestic trawl fisheries are conducted by vessels ranging from 30-110 feet in length, weighing under 200 gross tons. Trawlers based in northern Washington generally make trips of 6-10 days due to the greater distance to their fishing grounds. Vessels in the groundfish fishery operate year-round (PFMC, 1989). While bottomfishing occurs throughout the Washington coast, Swiftsure Bank, off the mouth of the Strait of Juan de Fuca is a popular bottomfish harvesting area. Some bottomfish fisheries such as the hake, which are migratory in nature, incorporate many, much larger trawling vessels, as well as large processing ships operating on the fishing grounds.

Gillnets and troll gear are used by the tribes to harvest salmon and steelhead trout. The Makah Tribe conducts a marine gillnet fishery along the shore near Cape Flattery and in the Strait of Juan de Fuca for chinook and sockeye salmon. The four coastal tribes also participate in the bottomfish fishery using longline and handline gear. These fisheries occur in the spring and fall and are centered off the north coast of the Olympic Peninsula.

In summary, vessels fishing for salmon operate from May 1 to October 31 throughout the study area, with heavier concentrations in the Strait of Juan de Fuca, especially when the Treaty gillnet fishery is in effect, off of Grays Harbor, and on Swiftsure Bank. The bottomfish fishery occurs throughout the study area during the entire year, with concentrations over Swiftsure bank as well.

#### vi. Pleasure Boats

Pleasure boating represents a large and expanding use of Puget Sound waters. The highest concentrations are centered around the San Juan Islands. In 1989, there were an estimated 160,000 boats registered in Washington, with over half of them remaining in Puget Sound (Washington Department of Health, 1989). There are 63 marinas located in the Strait of Juan de Fuca and

Puget Sound north of, and including, Port Townsend. By far, the largest concentration of marinas (44) are located in the San Juan Islands (WDNR, 1990).

**b. Washington State Ports and Harbors**

**i. Willapa Harbor**

Willapa Bay is bounded on the south by a low sandy peninsula known as Leadbetter Point, and on the north by the sandy peninsula of Cape Shoalwater. Willapa River and Harbor are used primarily by fishing boats engaged in the salmon, shrimp, crab and bottomfish fisheries, and also by barges transporting wood chips from Willapa Harbor to Longview on the Columbia River. There is an average of one barge per week entering and exiting Willapa Harbor (Littlejohn, 1992). There are no petroleum products transported by vessel into or out of Willapa Harbor.

The COE ceased dredging the Channel in 1976, at which time the depth was 26 feet over the bar at the mouth of Willapa Bay, and 24 feet from deep water in Willapa Bay to both forks of Willapa River at Raymond. No deep draft vessels have entered Willapa Bay since 1976 (US Department of Commerce, 1988).

Willapa Bar extends about three miles beyond a line joining Willapa Bay Light and Leadbetter Point. The bar channel is continually shifting, and depths over the bar vary seasonally. As a result, depths have consistently been less than the 26-foot project depth (US Department of Commerce, 1988). Today, the minimum depth of the channel over Willapa Bar is 21 feet (U.S. Department of Commerce, 1988).

An interim dredge disposal site is located approximately three and a half miles off the mouth of Willapa Harbor. The site has been used for disposal of dredge spoil from the bar at the opening of Willapa Bay. Although the site has not been used since 1976, the COE plans to utilize the site for three years, and then, due to the rate of shoaling, not for approximately another ten years. The site is currently being evaluated by EPA and the COE and is expected to be designated by 1994 (Findley, 1992).

**ii. Grays Harbor**

The entrance to Grays Harbor is approximately two miles wide, but shoals extending south from Point Brown narrow the navigable channel to a width of 0.7 miles (US Department of Commerce, 1988). From its entrance, the bay extends eastward for 15 miles to the mouth of the Chehalis River. The bay has many shoals and flats that are exposed at low water and cut by numerous channels. Pilotage is compulsory for all registered vessels (U.S. Department of Commerce, 1988).

Grays Harbor is an important outlet for the Washington State timber industry and represents an important lumber port in the foreign and domestic trade. A large number of vessels servicing Grays Harbor and Willapa Bay are engaged in coastwise service between ports in Washington, Oregon and California.

The Port of Grays Harbor operates three marine terminals. They include berthing space for three ocean-going vessels and one shallow draft vessel or barge (Port of Grays Harbor, 1988). In addition to the port-operated facilities, there are more than seven private deep draft piers and wharves in the Hoquiam, Aberdeen, and Cosmopolis area. Westport Marina is a modern fishing boat harbor in Grays Harbor with space for 800 boats. The Marina supports commercial fishing, seafood processing, recreational fishing and tourism, and ship building and repair industries. Two major railroads and two major highways service Grays Harbor. Bowerman Airport is owned and operated by the Port of Grays Harbor (US Department of Commerce, 1988).

The Port of Grays Harbor, the fifth largest deep water port in the State of Washington, is the only deep water port on the outer coast of Washington capable of handling vessels of up to a 36 foot draft. There have been over 2,500 bar crossings in Grays Harbor between 1980 and 1990 representing an average of 250 vessel crossings each year (Stevens, 1991). In 1988, harborwide trade of logs, lumber, wood chips, lignin and petroleum products handled by the Port and private terminals (Weyerhaeuser, ITT Rayonier, and Citifor) amounted to 5 million tons (Port of Grays Harbor, 1988). Refined petroleum products are barged into Grays Harbor from refineries in Northern Puget Sound.

In recent years there has been an aggressive effort to make the Port of Grays Harbor better prepared to handle an increasingly diversified mix of non-log cargo such as steel and aluminum products, paper products, wood products, machinery, granite and seafood products (Barkstrom, 1992). The COE, EPA and the Port of Grays Harbor have invested \$75 million in expanding and enhancing maritime activities in Grays Harbor through waterway dredging and port terminal development programs. This effort now enables the port to handle the largest ships that can pass through the Panama Canal. In 1991, approximately 31% of the cargo handled by the Port of Grays Harbor was non-log cargo. By 1992, the amount of non-log cargo handled by the port is expected to reach 50%.

Bunkering activities documented in 1988 included 14 transits from Tacoma to Grays Harbor by way of the Strait of Juan de Fuca transporting 465,658 barrels of bunker fuel. Within Grays Harbor, a total of 120 bunkering operations took place, transferring a total of 479,000 barrels of bunker fuel. The marketing terminal at Grays Harbor holds an inventory that accounts for the difference between inflow and outflow

(Chadbourne and Leschine, 1989).

Dredge spoil disposal is deposited at three EPA designated dumpsites outside the mouth of Grays Harbor. The dumping of dredged material helps control erosion occurring at the mouth of the harbor (Tipton, 1991). Regulated dumping of dredge materials into ocean waters falls under Sections 102 and 103 of the MPRSA. The designation of dredge disposal sites is delegated to the EPA. The COE is the permitting authority for dredged material. Two ocean dredge spoil disposal sites outside of Grays Harbor recently received final designation by EPA Region 10 (Federal Register Vol. 55, No. 129, July 5, 1990). These include the 3.9 mile site and an 8 mile site. The former site is used for disposal from the Corps' maintenance dredging program in Grays Harbor. It also received material from the Corps/Port of Grays Harbor Navigation Improvement Project (NIP) accomplished in 1990. The latter site only received material from the NIP in 1990, and has since been de-designated by EPA (Ploudre, 1991).

#### iii. La Push

La Push is a Quileute Indian village approximately one half mile north of the entrance of the Quillayute River. It is an important recreational and Indian fishing center. The river channel, maintained by the Corps of Engineers, leads from the sea to a small-craft basin at La Push. Approximately 200 berths are provided in the harbor of La Push (U.S. Department of Commerce, 1988). Dredge disposal material from the harbor at La Push is deposited on land.

#### iv. Neah Bay

Neah Bay, located on the Makah Indian Reservation, is located about five miles east of Cape Flattery just inside the Strait of Juan de Fuca. The existing Federal project constructed by the COE at Neah Bay consists of: 1) an 8,000 ft. long rubblemound breakwater between Waadah Island and the westerly shore of Neah Bay; 2) reinforcement of the existing rock revetment extending approximately 2,200 feet west from Baadah Point; and 3) an 800 ft. extension of the revetment westward. The breakwater was developed to provide a harbor of refuge. The rock revetment protects US Coast Guard facilities and Makah Tribal headquarters.

Neah Bay is used extensively by small vessels as a harbor of refuge in foul weather, and as a sport fishing site. There are also two cooperative fishing piers which have facilities for icing and supplying fishing boats, and a sea urchin processing plant. Neah Bay is a customs port of entry and customs officers also perform immigration duties (US Department of Commerce, 1989).

The Makah Tribe plans to develop the harbor at Neah Bay to provide a protected marina to support a changing commercial Indian and non-Indian fishery from a one-season, one species activity to a multi-species, year-round endeavor. The preliminary project plans aim to develop a marina that accommodates 275 boats. The harbor would be dredged to a minimum depth of 15 feet below mean lower low water. Dredge spoil will be used to nourish reservation beaches with the remainder deposited on land (Simmons, 1993). An emergency response towing vessel stationed at Neah Bay has been recommended to OMS by the Regional Marine Safety Committees.

#### v. Port Angeles

The Port Angeles harbor, located 56 miles east of Cape Flattery, is bounded by a long narrow spit of sand known as Ediz Hook. Logs, lumber, plywood, newsprint, pulp, shakes and shingles, and petroleum products are the principal commodities handled (US Department of Commerce, 1988). The port currently owns and operates two deep-water terminals with a total capacity of five vessels. Port Angeles harbor has the capacity to handle 2 million tons of export logs per year under existing conditions without significant additional costs to shippers for multiple shift working or vessel delays (Port of Port Angeles, 1992). In 1988, 51 bunkering operations took place. Approximately, 10,803 barrels of bunkering fuel was transferred per operation. Total bunker fuel transported in Port Angeles amounted to 550,951 barrels (Chadbourn and Leschine, 1989).

A ferry terminal supports ferry traffic that transits between Port Angeles and Victoria, B.C. A small craft basin supports a fleet of 563 fishing boats and pleasure craft, with pleasure craft accounting for 60% of the boats. A marina in Sequim Bay provides 272 permanent moorage slips and an additional 22 transient slips. The moorage will be expanded, as demand dictates, to a maximum capacity of 355 slips (Port of Port Angeles, 1992). The Port also owns and operates two airports, one at Port Angeles and one at Sekiu.

A pilot is required for all vessels greater than 1600 gross tons transiting east of Port Angeles. Some vessels require a state licensed pilot, while others require a federally licensed pilot (See RCW 88.16.070 and 46 USC 8501). The state may grant an exemption to pilotage requirements to smaller passenger vessels and yachts under 500 gross tons or 200 feet or less in length. Tugs in excess of 1200 horsepower are stationed in Port Angeles and tugs to 7200 horsepower are available in North Puget Sound and from Seattle with advance notice. Port Angeles is also a customs port of entry (U.S. Department of Commerce, 1988). The Port Angeles Coast Guard Air Station is located on Ediz Hook, in addition to a Coast Guard VTS radar tower and radio beacon and fog signal (US Coast Pilot, 1988).

#### **vi. Ports of Anacortes and Ferndale**

Large volumes of crude oil are transported to refineries in Anacortes and Ferndale. Refined products and petroleum coke are then transported by pipeline, truck, vessel and barge. In 1989, Anacortes and Ferndale received 41.9% and 51%, respectively, of the tanker transits transporting petroleum products into and out of Puget Sound (Chadbourn and Leschine, 1989). In 1988, nine bunkering operations were documented, averaging 30,662 barrels per operation. In Anacortes, five bunkering operations took place, averaging 30,251 barrels per operation (Chadbourn and Leschine, 1989).

#### **c. Economic Contribution of Vessel Activities**

Vessel traffic is intricately linked to the economy of Washington State, with an estimated one out of every six jobs in the state attributable to international trade (Kapp, 1987). On a local and regional level, the significance of vessel traffic to local economies is more profound. It was demonstrated that in 1988, port related activities in Grays Harbor generated 7,886 jobs (representing approximately 35% of the jobs in Grays Harbor County), and contributed over \$21 million in county tax revenues. The jobs created by port activities include trucking, logging, yard handling, and vessel stevedoring. The average annual wage for these jobs is \$21,085, 33% higher than the county average (Port of Grays Harbor, 1988).

In 1991, approximately 165 million board feet were handled at the Port of Port Angeles, generating 505 direct jobs, and indirect employment for over 1,388 people (Port of Port Angeles, 1992).

The economic contribution of the Ports of Anacortes and Ferndale to the Pacific Northwest is highly significant. Without the refineries, there would be no infrastructure to supply the Northwest fuel demand (Weiss, 1992).

#### **d. Vessel Management Regimes**

##### **i. Voluntary Management Initiatives**

Four voluntary management regimes address vessel traffic in U.S. waters of the Pacific Coast: 1) a WSPA agreement to keep coast-wise tanker traffic more than 50 nautical miles offshore when not entering port (Tomasovic, 1992); 2) a crabber-tugboat agreement to designate lanes for tugs and barges during crabbing season (Northwest Towboat Association, 1991); 3) the use of the Mukkaw Bay anchorage site off of the Makah Indian Reservation; and 4) the Cooperative Vessel Traffic Management System (CVTMS). The first two agreements have been discussed in the sections

The Mukkaw Bay anchorage, a mutually agreed upon site by both Canadian and U.S. Coast Guards, is used to minimize haphazard movements of vessels that are either waiting for a pilot in Port Angeles, or directions from home ports (Pokeda, 1992). The anchorage is not a designated anchorage and therefore not enforced nor maintained by the Coast Guard. However, it's use is monitored by Tofino Vessel Traffic Service. It is located just outside of the 3 mile limit of state jurisdiction, and thus convenient for ships to await orders, or available pilots without having to go through U.S. customs. The use of the Mukkaw Bay anchorage is monitored by Tofino Vessel Traffic Service (VTS) monitoring station. According to data provided by the Tofino VTS, approximately 35 vessels used the anchorage between May of 1989 and May of 1990. The average duration of stay at this site was 3.8 days per vessel.

The use of Mukkaw Bay as an anchorage site has created some management problems. One such problem involved the recent presence of the Asian gypsy moths on Washington and Vancouver Island beaches which has subsequently threatened coastal forests. It is presumed that the moth has been introduced by ships infested with larvae. Also, trash and low level oiling has been identified as a problem in the past, presumably due to vessel activities at the anchorage site. These nuisances have been reduced in recent years with the passage of MARPOL and more attention by the U.S./Canadian CVTMS.

#### ii. Cooperative Vessel Traffic Management Service

There are four aspects to the CVTMS: 1) required reporting by all vessels inbound to the Strait of Juan de Fuca greater than 500 gross tons; 2) a Traffic Separation Scheme (TSS) in the Strait of Juan de Fuca; 3) a vessel movement reporting system (VMRS); and 4) radar surveillance. To reduce the conflicts between fishing vessels operating at the mouth of the Strait of Juan de Fuca and commercial vessel traffic, Tofino Traffic Control Center in Canada and OMS have established a mandatory reporting regime where vessels greater than 500 gross tons bound for the Strait of Juan de Fuca report to Tofino Traffic Service when: 1) they are within 24 hours of either country's territorial sea (vessels greater than 300 gross tons are required to report to OMS); and 2) when approaching 50 nautical miles of Vancouver, or when crossing latitude 48°N inbound from the south, and longitude 127°00 W from the west (Figure 45). This reporting initiative allows enough time for Tofino VTS to assess language problems and deal with the vessels accordingly. If, during a pending emergency, a vessel captain can not speak english, Tofino is afforded enough time to explore other avenues to facilitate communications with the ship.

In addition, the Coast Guard and OMS have initiated an educational campaign to encourage vessel companies to ensure that

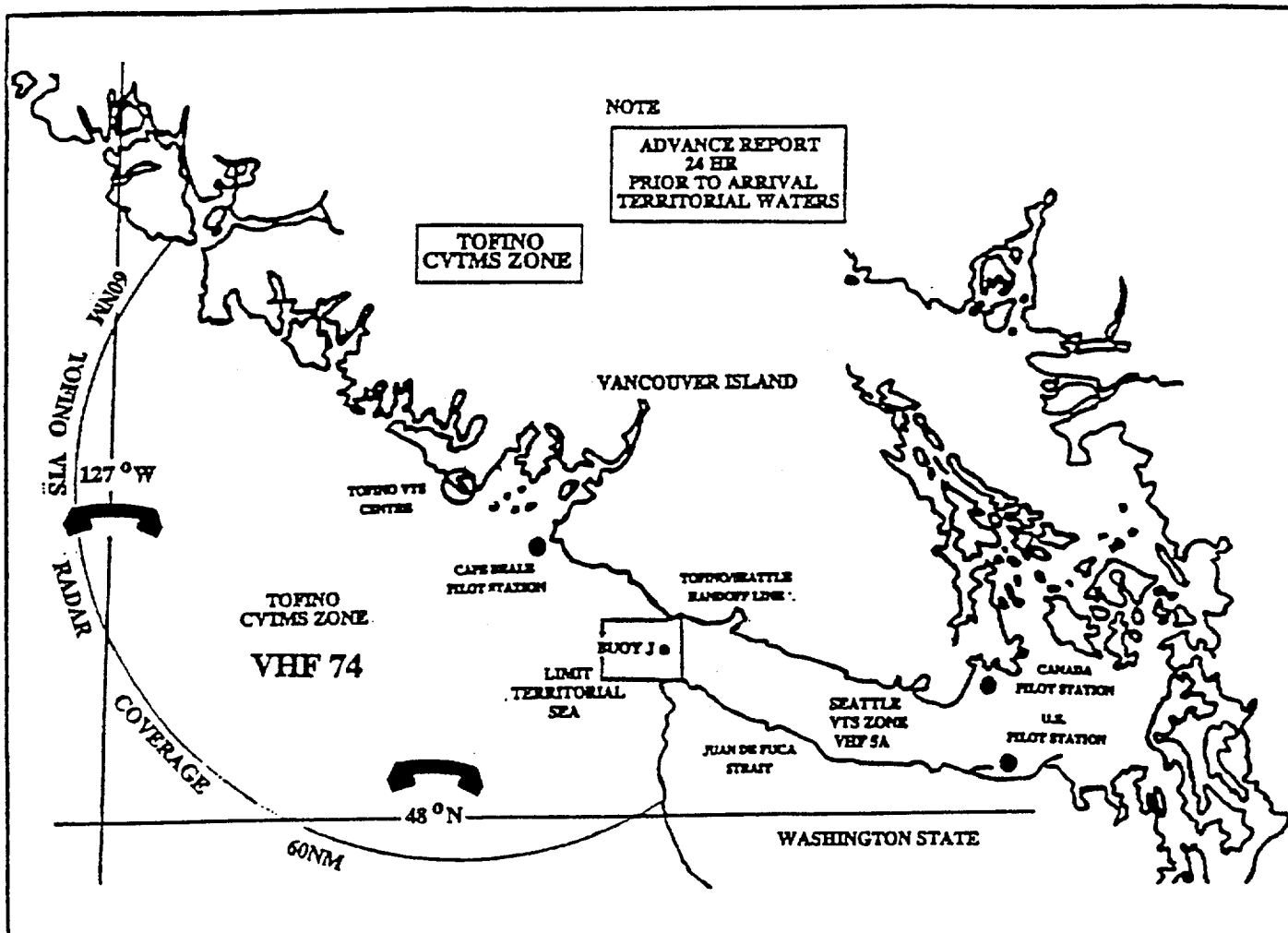


Figure 45. Vessel Traffic Management Service off the Strait of Juan de Fuca (CVTMS Offshore Traffic Management Task Force, 1991)

captains and/or at least one Deck Officer can speak adequate english. A monitoring effort is documenting the success of this campaign (Motekaitis, 1992).

The IMO sanctioned a Traffic Separation Scheme (TSS) consisting of all navigable waters of the Strait of Juan de Fuca and its offshore approaches (Figure 46). The US and Canada jointly operate the system within the waters of the Juan de Fuca region. The TSS is comprised of a network of one-way traffic lanes, and precautionary areas at the end points or where vessels normally join, leave, or cross the TSS. The traffic lanes are each 1,000 yards wide, and are separated by 500 yard wide separation zones. Most traffic lanes have a minimum depth of 60 feet.

Voluntary traffic separation schemes exist in southern Georgia Strait, the San Juan Archipelagos, Rosario Strait, Boundary Pass and Haro Strait. Two restricted areas are present within Puget Sound: Rosario Strait and Guemes Channel. No vessel over 20,000 DWT may enter these areas without VTC approval (33 CFR Part 161.37- Harbors, Marine Safety, Navigation (water), Telecommunications, Vessels, Waterways). Rosario Strait represents for large ships, the most difficult transit within the Puget Sound area. Rosario Strait is the site of the 13th Coast Guard District's "worst case" pollution scenario which envisions a tanker grounding, with subsequent cargo tank rupture, involving a major spill of crude oil. Rosario Strait is used by many small craft and ferries. When this type of traffic is combined with navigational factors such as strong tidal currents, the resulting hazard warrants imposition of the "one-way" Rosario Strait VTS rule. Hence, tankers moving through Rosario Strait are accompanied by an escorting tug, voluntary speed restrictions apply, and the Strait is regulated as a one-way channel for large ships (U.S. Coast Guard, 1991).

According to conclusions reached by the Port Needs Study conducted by the U.S. Coast Guard in 1991, the priority for the existing VTS system in Puget Sound is to modernize the present vessel traffic control center. The surveillance and communications workload created by the repetitive ferry crossings and the channel interference caused by commercial fishing boats must be reduced through enforced regulation and VTS automation. There are a number of improvements/upgrades occurring at VTS Puget Sound including a Tacoma extension, a new Vessel Traffic Center, closed circuit TV cameras in Seattle and Tacoma, direction finders/weather monitors at radar sites, communications improvements, a new voice hotline with the Canadian VTS's and a new computer data link with the Canadian VTS's (Norman, 1992).

The Joint Coordinating Group (JCG) is the Canadian/U.S. body which oversees the CVTS in the Pacific Northwest. Recent issues addressed by the JCG include: 1) communication problems with non-

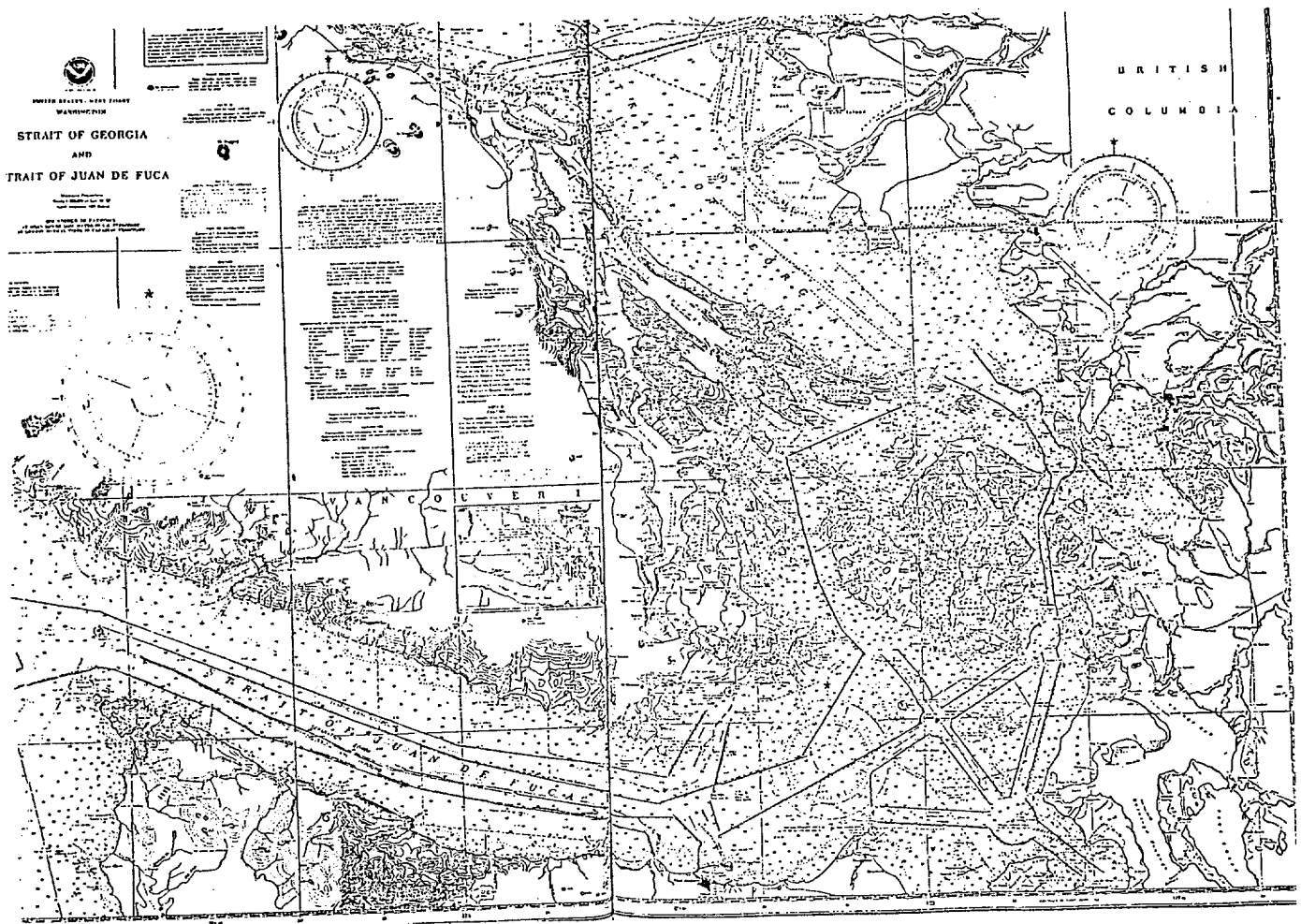


Figure 46. Traffic Separation Scheme in the Strait of Juan de Fuca and Puget Sound (U.S. Coast Guard, 1987).

procedures; 3) vessel routing schemes in the offshore approaches to minimize conflicts with fishing vessels; and 4) shortcomings in mariner awareness of available services. The JCG commissioned a task force to address these problems and initiatives have been developed which are now being implemented.

#### **e. Contingency Plans**

##### **i. Oil Pollution Act of 1990 (OPA 90)**

The Oil Pollution Act of 1990 creates a comprehensive prevention, response, liability, and compensation regime for addressing vessel and facility-caused oil pollution. It substantially increases Federal oversight of oil transportation by setting new requirements for vessel construction, crew licensing and manning; mandates contingency planning; enhances Federal response capability; broadens enforcement authority; increases penalties; and creates a new research and development program. A one billion dollar trust fund is available to cover cleanup costs and damages not compensated by the spiller, whose financial responsibility requirements are significantly increased.

Six Titles apply directly to the proposed Olympic Coast Marine Sanctuary. **Title I** creates a liability and compensation regime for tank vessel and facility-source oil pollution. Any party responsible for the discharge, or the substantial threat of discharge, of oil into navigable waters or adjoining shorelines is liable for the removal costs and damages for injury, destruction, loss or loss of use of natural resources, including assessment costs, real or personal property damages, subsistence use, lost government revenues, and lost profits and earning capacity. NOAA has the responsibility of promulgating damage assessment regulations. Sums recovered by a trustee for natural resource damage will be retained in a revolving trust account to reimburse or pay costs incurred by the trustee with respect to those resources.

**Title II** makes numerous amendments mandating that other Federal statutes conform to the provisions of the Oil Pollution Act.

**Title III** encourages the establishment of an international inventory of spill removal equipment and personnel.

**Title IV** is divided into three subtitles: A) Prevention; B) Removal and C) Penalties and Miscellaneous. Subtitle A gives added responsibility to the Coast Guard regarding merchant marine personnel, including the review of alcohol and drug abuse and review of criminal records prior to issuance and renewal of documentation. It also increases the responsibility of the Coast Guard to regulate the conduct of tankers by requiring some

vessels to participate in vessel traffic service systems, and authorize the expansion, construction, improvement and operation of vessel traffic systems in U.S. ports.

More specifically, Subtitle A establishes double hull requirements for tank vessels. Most tank vessels over 5,000 gross tons will be required to have double hulls by 2010, while vessels under 5,000 gross tons will be required to have double hulls or double containment systems by 2015. All newly constructed tankers must contain a double hull (or double containment system if under 5,000 gross tons), while existing vessels are phased out over a period of years.

Subtitle B amends subsection 311 (c) of the Clean Water Act (CWA), requiring the Federal government to ensure immediate removal from navigable waters or adjoining shorelines of any oil or hazardous substance that threatens to affect natural resources. It also requires a revision and republication of the National Contingency Plan within one year which will include, among other things, a fish and wildlife response plan developed in consultation with NOAA and USFWS. Nothing in Subtitle B preempts the rights of States to require stricter standards for removal actions.

Subtitle C alters and increases civil and administrative penalties for discharges and violations of regulations under the Clean Water Act. As well as criminal penalties, other penalties are included for negligent operations and failure to comply with Federal law on carriage of liquid bulk dangerous cargoes, load lines, manning, and crew complements and requirements. Financial responsibility and civil penalties may be assessed up to \$25,000 per day. All penalties are to be paid into the Oil Spill Liability Trust Fund.

**Title VII** authorizes oil pollution research and technology development, including the establishment of an Interagency Coordinating Committee, that is chaired by Department of Transportation and comprised of representatives from the Departments of Energy, Interior, Commerce (NOAA), EPA, Federal Emergency Management Agency, National Aeronautics and Space Administration, and the U.S. Fire Administration.

**Title IX** amends the Oil Spill Liability Trust Fund and increases from \$500 million to \$1 billion the amount that can be spent on any single oil spill incident, of which no more than \$500 million may be spent on natural resource damages.

#### ii. State Framework for Contingency Planning

After the spill from the Nestucca barge in 1988 off of Grays Harbor, Washington, the Governor of Washington and the Premier of British Columbia created the B.C./Washington Task Force on Oil

Spills. The mission of the task force was fourfold: 1) to seek ways to prevent oil spills; 2) to review oil spill response procedures; 3) to study methods of determining compensation claims; and 4) to develop a coordinated plan for preventing and responding to spills. Following the Exxon Valdez spill in 1989, Alaska, Oregon and California joined the task force and it was renamed the B.C./States Task Force. In its final report, the Task Force made 46 joint recommendations involving issues of vessel traffic, vessel design, personnel, enforcement, regulatory oversight, education, interstate cooperation, and future studies. The State of Washington proposed an additional nine recommendations for state action including efforts to reduce navigation conflicts (Final Report of the States/B.C. Oil Spill Task Force, 1990).

The Washington State Legislature adopted several provisions recommended by the States/B.C. Task Force. In 1991, the State Legislature passed Washington ESHB 1027 which establishes the infrastructure for marine spill response. Included in this infrastructure are the WDOE, the newly created Office of Marine Safety (OMS), the Maritime Commission, Regional Marine Safety Committees, the Board of Pilotage Commissioners, University of Washington Sea Grant, the Marine Oversight Board (MOB), and existing state agencies including Washington Parks and Recreation Commission, WDNr, WDW, WDF, and Department of Revenue.

The USCG (the Federal on-scene coordinator in coastal and tidal waters) has ultimate authority to coordinate and direct all Federal, state and private cleanup operations when discharges pose a substantial threat to the public health or welfare.

WDOE has primary responsibility for oil and hazardous substance spill response and clean-up on land and water. It focuses, however, on land-based oil storage operations.

The primary focus and jurisdiction of OMS is vessel oil spill prevention. OMS also has responsibility to ensure adequate spill response planning. The OMS has undertaken five initiatives to fulfill its responsibilities: 1) the establishment of four regional marine safety committees including one for the North Puget Sound/Strait of Juan de Fuca and one for the Outer Coast to address vessel operations and regional traffic patterns; 2) the adoption of tank vessel oil spill prevention plan rules to insure that individual vessels operations provide the best achievable protection from oil spills; 3) the adoption of cargo and passenger vessel screening rules to ensure that individual vessels do not pose a substantial risk of harm to public health, safety, and the environment; 4) a vessel monitoring program; and 5) education and technical outreach programs.

The regional committees were charged with preparing plans addressing the safe navigation and operation of tankers, barges,

and other vessel traffic within its specific region. The plans must consider tug escort requirements, speed limits, anchorage designations, communication systems, congestion in shipping lanes, navigation aids, channel design plans, routings from port construction and dredging projects, routing vessels during emergencies, management requirements for vessel control bridges, environmentally sensitive areas, enforcement mechanisms, and adequacy of the Coast Guard VTS. The plans were submitted to OMS in May, 1993. OMS is currently reviewing the plans and will submit its recommendation by December, 1993. OMS will then implement the recommendations over which the agency has jurisdiction and will pass the recommendations for issues over which it does not have jurisdiction to the appropriate federal or state agency. The work of the committee has been ongoing and it will continue to make recommendations and update existing ones.

The OMS will be establishing an emergency response system for the Strait of Juan de Fuca after receiving recommendations from the regional marine safety committee. The emergency response system will address emergency towing and firefighting capabilities, and emergency response availability. The subcommittee recommendations have been submitted to the regional committees for review as of February 10, 1993. OMS' Vessel Screening Program will be used to select cargo and passenger vessels that pose a risk to the safety of Washington waters. These vessels will be boarded and inspected as a part of the Vessel Monitoring Program. Submitted Tanker Prevention Plans will be used by the Vessel Monitoring Program to select and board the tank vessels that pose a risk to the safety of Washington waters.

The Oil Spill Prevention Plan rules, effective in September, 1993, will require tankers and tank barges transiting Washington waters to file an oil spill prevention plan with the OMS. The plan must ensure that tank vessels demonstrate the "best achievable protection" from oil spills. The prevention plans must demonstrate minimum compliance with respect to staffing, vessel inspection programs, spill prevention training, prevention technology on board, English language proficiency by at least one bridge officer through procedures adopted by the vessel owner or operator. The Oil Spill Prevention Plan program will be implemented in three phases involving: 1) establishment of standards for interim prevention plans; 2) adoption of plans requiring detailed comprehensive information about a vessel and its operations to aid in defining "best achievable protection"; and 3) establishment of standards for achieving the best achievable protection. The best achievable protection standards are scheduled to be implemented by July, 1995. The 1993 Prevention Plans will be effective for five years. New plans will be required in 1998 and best achievable protection standards will be revised as required.

Commercial Vessel Screening rules, addressing cargo and passenger vessels over 300 gross tons will result in a data base of all vessels transiting Washington waters including information on the vessels cargo characteristics, the vessels operating characteristics, and operating environment, past incidents and human factors. All vessels are required to give 24 hour advanced notification of their arrival and include a safety report.

The vessel screening data base and submitted prevention plans will be used by the Vessel Inspection Program to select vessels that pose the greatest risk to the safety of Washington waters. These vessels will be boarded and inspected for compliance with state and federal regulations. OMS is studying the use of tax credits and other financial incentives to encourage industry compliance with safe marine transportation practices.

The Maritime Commission, established by the Legislature in 1990, is charged with: 1) developing first response oil spill contingency plans for covered vessels; 2) providing emergency oil spill response services for up to 24 hours of an oil spill incident; and 3) providing a 24-hour communication network for spill response notifications. Both of these functions have been contracted-the former to Foss Environmental and the latter to the Marine Exchange of Puget Sound. The Commission develops vessel contingency plans and is planning to maintain a database of vessel accidents.

Numerous state agencies provide spill response assistance and planning information related to resources that may be impacted by a spill. Education and outreach efforts are provided by the University of Washington Sea Grant and Washington Parks and Recreation Commission. The MOB provides independent oversight of the actions of the federal government, industry, the Department of Ecology, OMS, and other state agencies with respect to oil spill prevention and response for covered vessels and facilities. The MOB is comprised of five gubernatorial appointees, who, acting in an advisory role report to the Governor, and make recommendations to agencies and the State legislature.

### iii. Response Readiness for Oil Spills

Many of the provisions established by Washington ESHB 1027 are similar to those promulgated by OPA90, including the requirement for vessels to have their own contingency plans approved by OMS before they are allowed to enter state waters. To meet the stringent contingency plan requirements of OPA90 and State legislation, many vessel owner/operators contract with an oil spill response contractor in the State which has the necessary equipment and trained personnel to respond to a "worst-case scenario" identified for their particular vessel.

While the USCG has ultimate authority over a marine incident, there are numerous response mechanisms and capabilities in the private, non-profit and government sectors to address a spill incident involving oil. If, at any time, the clean-up response effort is deemed to be inadequate, the USCG can step in and contract with a local resource, or call out the strike team in San Francisco which has large ocean lightering and pumping equipment and aircraft. The USCG can also call upon the resources of the Navy which has mobile skimmers, and pumping and lightering equipment. If the responsible party is taking proper action, the USCG and the state will monitor the events.

When a spill occurs, the Maritime Commission is called upon to respond during the first 24 hours unless the vessel has its own contingency plan and primary response contractor, after which the designated responder assumes control over the incident (House Bill Report ESHB 1027). Among the responders in the study area are one large cooperative (Clean Sound Cooperative), private contractors (Foss Environmental, Global Diving and Salvage Inc., and the Maritime Corporation - a division of Crowley Environmental Services), and the soon-to-be-established Marine Spill Response Corporation. A worst probable case scenario/plan is in place to enable all area agencies dedicated to oil spill response to combat a spill in Puget Sound of approximately 1,322,000 barrels.

Clean Sound Cooperative, organized in 1971, is a non-profit, regional oil spill response organization funded by its industry members including oil, oil pipelines and transportation companies. They focus on the containment of spills in open water up to 20 miles from shore. Clean Sound owns, maintains and operates a fleet of specialized oil spill response equipment and cleanup vessels stationed throughout Puget Sound at Bellingham/Ferndale, Anacortes, Edmonds, Seattle, Tacoma and Port Angeles. The cooperative also maintains more than 30 crew members and backup contractor crews. Its crews and equipment are prepared for immediate response, regardless of the location, time of day or weather conditions. Clean Sound plans to involve commercial fishermen in their response efforts by equipping vessels with oil containment barriers designed to fit their existing fishing net reels (McCartan, 1992).

Foss Environmental Services has contracted with Washington State's Maritime Commission to provide a first response system to a spill. This division also provides standby response services to several facilities and emergency oil spill response services to other potential spillers. Foss Environmental is a division of the tug and barge company of Foss Maritime. Foss maritime has approximately 65 tugs and 65 barges, although these tugs and barges are not dedicated vessels. Among these, there are approximately 15 tank barges in use in Puget Sound at any one time that can be called upon to assist a spill in inland waters

(Felton, 1992).

Foss Environmental has equipment pre-staged at eight locations around Washington State covering all of Puget Sound, the Strait of Juan de Fuca and offshore waters. This equipment is dedicated to marine spill response incidents. Pre-staging locations are Bellingham, Anacortes, Everett, Seattle, Tacoma, Willapa Bay, Aberdeen, and Port Angeles. The equipment is pre-staged to respond to a spill in all State waters navigable by vessels 300 tons and greater (with the exception of the Columbia River) within two hours. Their equipment includes nine fast response vessels capable of speeds in excess of 30 knots and equipped with 1000 ft. of boom; 34,000 ft. of boom aboard fast response vessels for rapid deployment with recovery capacity of over 20,000 bbls. per 24-hr. period at a 20% efficiency rating (1000 feet aboard each fast response vessel and the balance containerized for rapid deployment over land or by air); over 100 OSHA/HAZWOPER trained response personnel and 30 standby personnel on-call 24 hrs./day 365 days/yr (Barton, 1992).

Global Diving and Salvage, Inc. is a private contractor specializing in salvage operations, and the cleanup of beaches, coastal and inland waterways, and rivers. They respond on a daily or weekly basis to incidents in harbors, ship canals and along the coast. Their inventory includes small coastwise tug-boats including a 70 ft. tug, a fleet of work boats, several thousand ft. of containment boom, a variety of skimmers, and a 40 ft. barge. They have no ocean-going vessels and no ocean-going equipment except high-capacity lightering systems which pump up to 300 gallons per minute (Craig, 1992).

The Crowley Environmental Service is a division of Crowley Maritime Corporation, the largest tug and barge company in the world. The Maritime Corporation, when approved, will concentrate on marine response efforts as opposed to beach clean up efforts. They have access to numerous barges and tugs, salvage operations, and are amassing booms and skimmers to operate in the marine environment. Due to the mandates of OPA90 and State Legislation, they will concentrate on Puget Sound and Washington State Waters. Expecting to be fully operational by the end of 1992, Maritime Corporation will preposition equipment in high risk areas yet to be determined (G. Douglas, 1992)

The Marine Spill Response Corporation (MSRC) will be in operation in 1993 to address catastrophic spills of over 25,000 barrels in open seas and 40,000 barrels in protected waters. Under MSRC's charter, the decision as to whether the spill exceeds local response capabilities will be determined by the USCG. MSRC is a not-for-profit organization funded by the Marine Preservation Association (MPA). MPA collects dues from oil, pipeline, and tug and barge companies. Both MPA and MSRC were formed on the recommendation of a task force organized after the

Exxon Valdez spill to examine existing resources for responding to catastrophic oil spills. MSRC is the response to the OPA90 provisions mandating that by 1993 vessels must be able to respond to catastrophic spills. MSRC has five regional centers throughout the United States and, if needed, they can call on personnel and equipment from other regions to assist. This ability will make it the largest oil response agency in the world. MSRC is not intended to replace existing oil spill cooperatives and independent response contractors. Rather, it will respond when the existing infrastructure does not have sufficient resources to respond to a large spill (Patterson, 1992).

There will be three pre-staging areas where MSRC's equipment, and, at times, vessels and personnel will be located. Pre-staging areas are planned for Everett, Bellingham and Port Angeles, WA as well as Astoria, Oregon. MSRC will provide a best-effort response to major spills of persistent oil (oils that do not evaporate or degrade quickly) in U.S. coastal and tidal waters (out to the limits of the U.S. EEZ) that are beyond the capacity of local response organizations. In addition to its own equipment and personnel, a variety of subcontractors will provide support.

Among the equipment inventory planned for the Seattle area is a 208 foot offshore response vessel, numerous smaller work boats, booms, skimmers and pumping equipment. A second response vessel will be moored at the Astoria site. Onshore facilities will include an 80,000 sq. ft. warehouse including administrative offices, a training center, test tank and a 24 hr. manned response center (Patterson, 1992).

As a result of OPA90 and Washington State legislation, all state waters are covered by numerous vessel contingency plans. In Washington State, there are currently no tugs and only two barges exclusively dedicated to oil spill response although the Marine Spill Response Corporation plans to dedicate two barges for oil spill response. These two barges are owned and operated by Clean Sound Cooperative. Supporting the barges dedicated to spill response, are a large number of tugs and barges in constant operation within Puget Sound which are available in the event of an emergency (Felton, 1992).

#### iv. Emergency Towing Response for Vessels and Tugs/Tows Adrift

While management of vessels into and through the Strait of Juan de Fuca and Puget Sound is well coordinated, and contingency planning has, and is, being addressed through a number of Federal, State, regional, private and non-profit initiatives, the very real possibility of a vessel or tug and tow losing power near the sensitive offshore habitats of the outer coast and

Strait has not been adequately addressed. There have been well publicized instances when barges and vessels have lost power causing, or threatening to cause, damage to coastal resources. Some examples in recent history include the grounding of the Nestucca barge in 1988 off of Grays Harbor involving a spill of over 200,000 gallons of oil, in addition to the Exxon Philadelphia and Exxon San Francisco which lost power off Cape Flattery in 1989.

Although there are contingency plans in place, no response strategies exist to respond to such occurrences off the Washington Coast and in the Strait of Juan de Fuca. No vessels are specifically designated to respond to an emergency in which a vessel or tug and tow loses power in these areas. While there are several major towing and salvage companies in the area, the time of response to an emergency occurring off the outer coast requiring towing would depend on both vessel availability and distance from the scene of the incident. Emergency response could be significantly delayed due to prior assignment of response vessels to other towing, docking, or salvage operations, or the remote location of an incident from available vessels.

The United States Navy has several tugs in the Puget Sound area, however all are yard craft rather than ocean going vessels. Further, none are dedicated, nor readily available for emergency response. In addition, the U.S. Coast Guard has no tugs in the area (COMSUBGRU 9, 1992). The initial USCG response to a drifting vessel or tug and tow are primarily Search and Rescue missions aimed at protecting human life. The Canadian Coast Guard operating from Victoria has five vessels: two are assigned primarily to search and rescue missions, and three are buoy tenders. In an emergency, one of these vessels might be able to render assistance to a small disabled commercial vessel or drifting tug and tow (Cheng, 1992).

The OMS, with the benefit of recommendations from, and in coordination with the regional marine safety committees and the Marine Oversight Board, and in consultation with the province of British Columbia, is mandated by the legislature to establish an Emergency Response System for the Strait of Juan de Fuca. The system will address emergency towing capability for vessels in these waters.

#### 4. Military Activities

Military activities in the area of the Sanctuary consist of subsurface, offshore surface, and aerial operations. Navy submarines homeported in Puget Sound conduct three types of operations within the sanctuary study area: 1) transit between Puget Sound and the undersea operating areas; 2) hull integrity tests and other deep water tests of 1 to 2 weeks duration, which are performed in a rectangular area between 7 to 30 miles off

Cape Johnson; 3) in-water testing of non-explosive torpedoes, 6-8 times per year, lasting from 1 to 4 days, in a rectangular area 5 to 14 miles off Kalaloch; and 4) the barging of defueled nucleau reactor compartments from Puget Sound to the Columbia River.

Ongoing operations near the entrance to the Strait of Juan de Fuca include surveys for hidden obstacles by Navy minesweepers to ensure that in the event of hostilities or other incidents affecting national security, Navy ships would be able to pass safely to sea. The details of these operations are classified, however, they are generally limited to passive surveying and do not involve active sweeping or clearing. The Navy also operates an acoustical net off Washington, with its operations base located at NAS Whidbey Island.

The Seattle Sectional Aeronautical Chart shows two Warning Areas (W-237A and W-237B) which are designated training and operating areas for the Pacific Fleet air and surface forces, two Military Operation Areas (MOA Olympic A and B), and Restricted Area R-6707 (Figure 47).

The two Warning Areas extend from three miles off the coast out to a distance well beyond the sanctuary study area, from approximately 48°09'N latitude due south to approximately 46°55'N latitude. Air operations in W-237A (the southern half of the study area) include air combat maneuvering, air intercept, air refueling, air-to-air gunnery and rocketing, air-to-surface gunnery and missile exercises, anti-submarine warfare training, and other training evolutions, at altitudes from the surface to 50,000 feet above mean sea level. In W-237B area, air operations are basically the same. In W-237A, ordnance is expended under controlled conditions that attempt to minimize threats to the living environment and to ensure the safety of other ships and aircraft that may be operating in the area. Anti-submarine warfare operations require the expenditure of sound receiving and transmitting buoys, called sonobuoys, as well as marine smoke markers from aircraft. Sonobuoys eventually flood and sink to the bottom after use.

Surface operations in W-237 consist primarily of routine transit, single and multiple platform maneuvering, as well as live firings of guns, missiles, torpedoes, and chaff. Any vessel or aircraft requiring exclusive use of W-237 schedules the area with NAS Whidbey Island. For calendar year 1991, W-237 was scheduled for 2,572 hours out of a possible 8,760 hours. During this time frame there were a total of 575 events. According to Boeing and the Federal Aviation Administration, these events were distributed as follows: 156 Navy aircraft, 224 Air Force aircraft, 131 Coast Guard aircraft, 10 Navy ships, 27 coast guard ships, and 27 civilian aircraft.

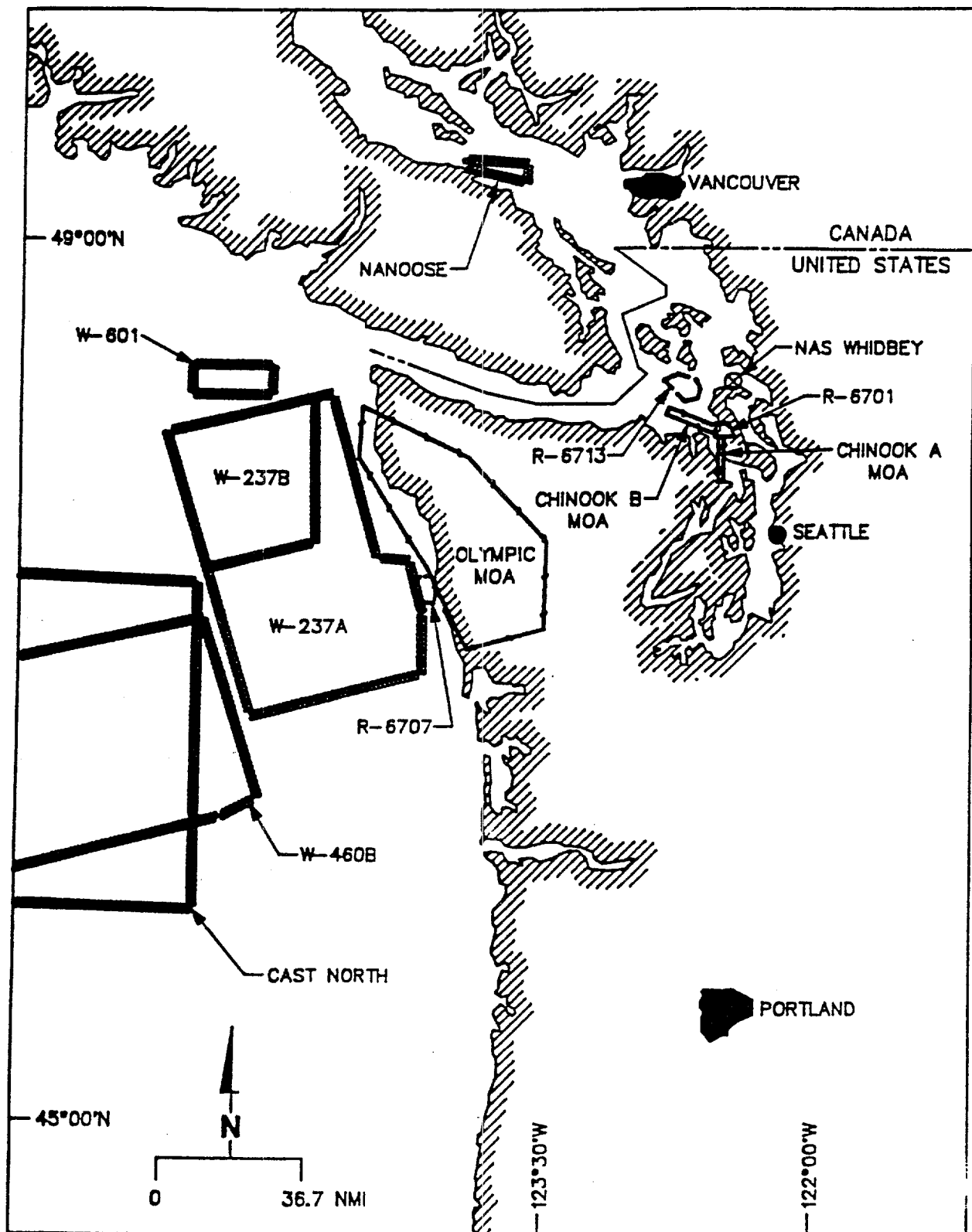


Figure 47. Zones of Military Activity off Washington Coast, (Whidbey Island Complex, West).

The Navy operates and maintains an undersea test range located in Navy Operations Area W-237-B (Figure 48). This range is known as the Quinault Range, and is instrumented to track air craft, surface vessels, submarines, and various undersea vehicles (non-explosive torpedoes, mines, counter-measures, etc...) for both the Navy and private industry. The range is available for operation year round, and test operations are typically conducted 8-15 times per year, each operation lasting from 1-7 days. In all cases, only non-explosive testing is conducted.

The typical test scenario in the Quinault range involves: 1) oceanographic measurements prior to a test exercise; 2) test vehicle launching; 3) underwater and above water tracking of participating craft and test vehicles during the test; and 4) recovery of all test vehicles from the water surface by vessel or aircraft or from the seabed by vessel and remote controlled recovery vehicle at the conclusion of the test exercise. The above-water tracking instrumentation uses standard Global Positioning System and radio telemetry equipment and covers the range and surrounding area as required to conduct operations. The undersea instrumentation, all located on the ocean floor, consists of tracking sensors connected by coaxial cable to junction boxes. The junction boxes are connected by fiber optic and coaxial cables to the range's shore termination sites at Kalaloch and Pacific Beach.

The range is located approximately 7.5 miles off the Washington coast at Kalaloch within Military Operating Area W-237 and its area is approximately 30 square nautical miles, centered at latitude 47°30'N and longitude 124°37'W. The location and/or size of the undersea tracking area is adjusted from time to time to support specific Navy testing requirements, but it remains within W-237.

There are a variety of activities that take place within the sanctuary area in support of Quinault Range use and maintenance. Testing operations are supported by a variety of surface and air craft. Vessels transit to the range, position and temporarily moor throughout the test areas, and launch and recover test vehicles as required to meet test objectives. Navy aircraft are periodically used to launch test vehicles and helicopters provide range surveillance and may be used for test vehicle recovery. Helicopter operations include staging at shore sites, typically Forks or Pacific Beach, and transit to and from test areas, at altitudes from the surface to approximately 1,000 feet above mean sea level. Testing of autonomous and acoustic homing vehicles involve sonar searches and sonar target size measurements. Maintenance requires replacement of underwater instrumentation and cabling in the identified range area and along paths to shore termination sites. Maintenance activity involves using temporarily anchored surface vessels to support retrieval and placement of underwater sensors, junction boxes and cable laying

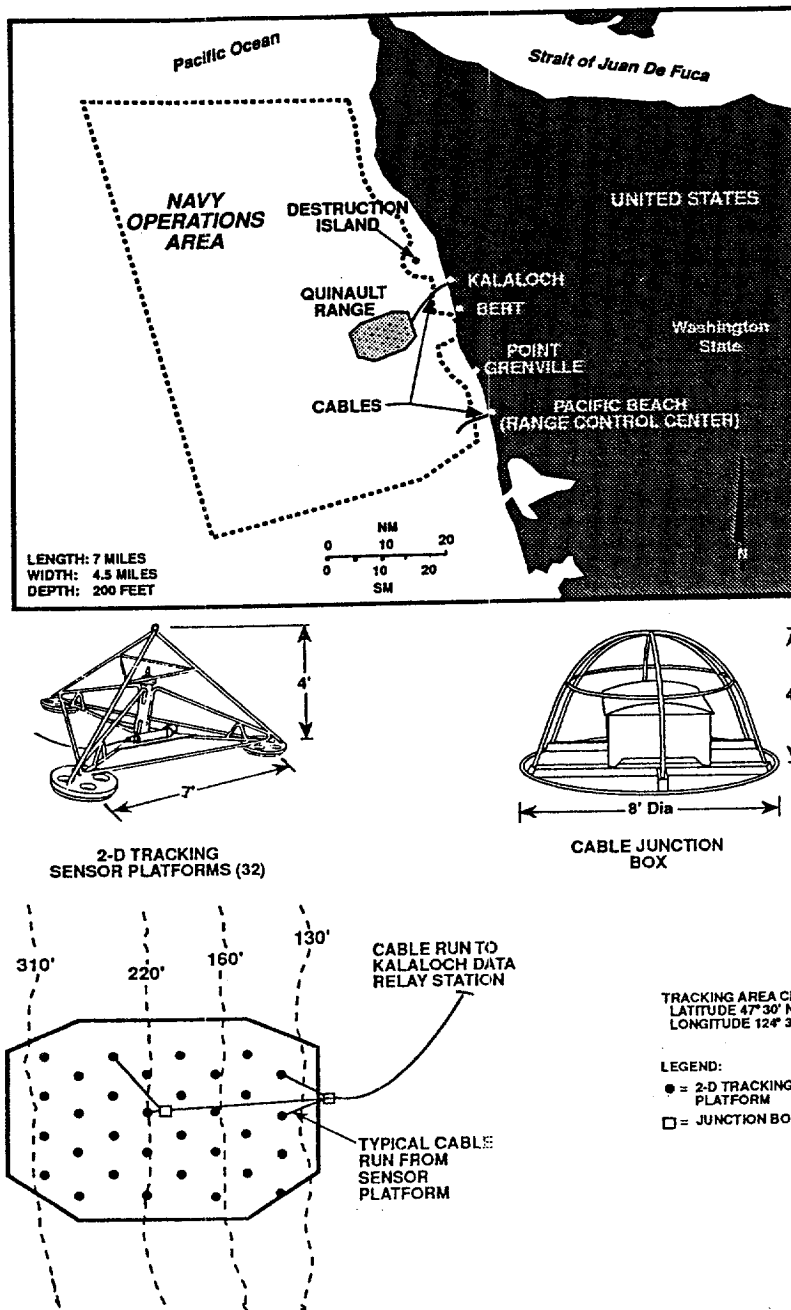


Figure 48. Quinault Range Tracking Area and Bottom-Mounted Instrumentation.

on the seabed.

Navy ranging activities primarily produce the type and level of discharges associated with normal surface vessel traffic. On rare occasions some of these activities are conducted outside W-237 due to unique conditions or requirements such as lost/sunken vessels or equipment, requests for assistance by other groups, and classified operations. For example, the Ex-BUGARA (sunken submarine located off Cape Flattery) is used for Naval undersea test tracking operations.

The Navy regards W-237 to be a key part of the Pacific Fleet offshore training complex in the northeast Pacific, which is essential to unit training, and overall Fleet readiness. For air operations, W-237 is particularly desirable from a cost standpoint because it is close to the coast and therefore requires fewer flying hours and steaming hours to reach. The importance of these areas is expected to increase by the mid-1990's with the addition of a carrier battle group at a new homeport in Everett, Washington. Puget Sound will become home to several additional Navy warships and support vessels, and the relatively few surface operations currently conducted off the Washington coast should increase, although the exact number of the increase is unknown. Operating costs will drive the need to conduct routine battle group training in W-237 and the surrounding operating areas.

The Olympic MOA A and B, which are primarily over land, also extend three miles offshore throughout much of the sanctuary study area. Air operations within the Olympic MOA's include combat tactics, flight training, intercepts, instrument training, tanking, and formation at altitudes from 6,000 to 35,000 feet above mean sea level; but this is not to be below 1,200 feet above the ground. No ordnance is allowed. The MOA is scheduled for approximately 1,300 hours of a possible 8,760 hours per year.

A restricted air space (R-6707) extends from the coast out four miles just south of Queets and north of Taholah (Figure 49). The following described actions conducted in this training area were, until recently, considered vital to national defense. With the downsizing of the Navy, however, this training site is no longer considered as vital to Fleet readiness.

Sealion Rock, a 80' by 30' uninhabited volcanic rock, awash at high tide, was historically the sole target within R-6707. It is located at 47° 27' N latitude and 124° 24' W longitude, approximately 2.7 nautical miles off the coastline. This site was used exclusively as an alternate practice bombing range for Navy A-6 aircraft from NAS Whidbey Island, and from aircraft carriers in the North Pacific during Fleet exercises. Only inert ordnance was dropped, and only in accordance with established flight procedures detailed in an approved Operations Plan.

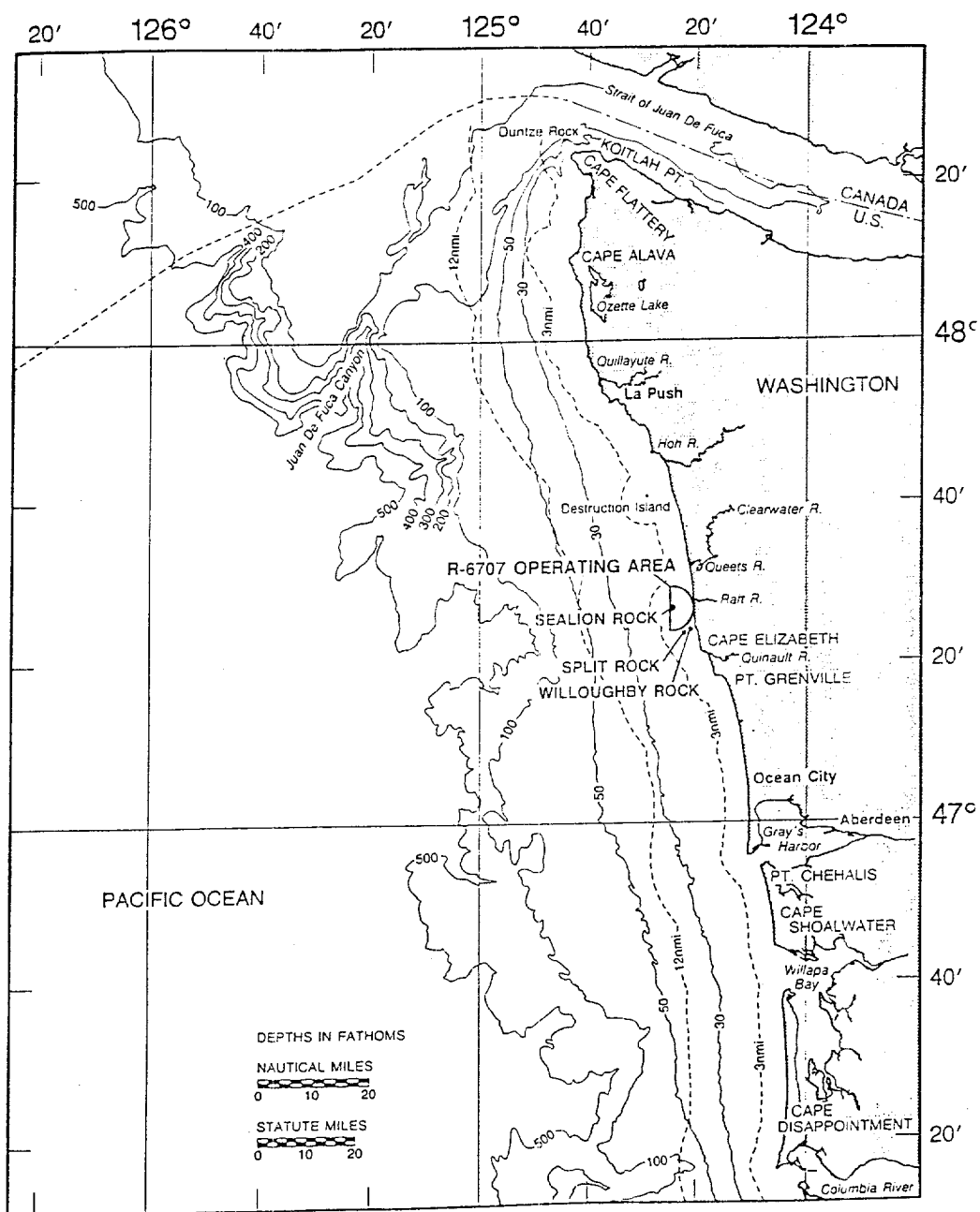


Figure 49. Restricted Airspace R-6707.

Procedures in the flight operations plan dictated a north to south pass from Destruction Island to Sealion Rock. Aircraft were not to descend below 3,000 feet until they were two miles south of Destruction Island. All exit turns were to the west, away from the coast. Prior to practice bombing runs, a clearing pass was undertaken over Sealion Rock to clear the rock of marine mammals. If any marine mammals remained on the rock, an additional clearing pass was required. All clearing passes were below 500 feet.

The primary and alternate routes by which Navy planes arrived at R-6707 is depicted in Figure 50. Prior to entry into the Olympic MOA, aircraft operated on instrument flight rules (IFR) under positive control of the Seattle Center aircraft traffic control at altitudes of between 6,000 and 23,000 feet above ground level. Within the MOA, the aircraft operated on visual flight rules (VFR) at altitudes ranging from surface to 6,000 feet. Aircraft continued to fly as VFR traffic at altitudes ranging from SFC to 6,000 feet into R-6707 (Munsell, 1992).

Statistics on the number of days per month and days per year that A-6 aircraft originating from Whidbey Island and the Pacific Fleet used Sealion Rock from 1986 through 1992 is presented in Figures 51 and 52, respectively. Usage of Sealion Rock has declined from 18 to 5 days per year from 1986 to 1992. Likewise, the number of hours in which A-6 bombers have maneuvered over Sealion Rock has declined from 31.35 hours in 1986 to 9 hours in 1992. The number of aircraft from the Pacific Fleet carriers that actually dropped inert ordnance on Sea Lion Rock is unknown.

Permission to use Sealion Rock and three other coastal islands and rocks located in each of the three National Wildlife Refuges was granted to the Navy by the Secretary of the Interior in May, 1944. The Navy was denied permission to use a fifth rock, Carroll Island, because of nesting activity. The Navy's use of the islands was to cease six months after the end of World War II. In July, 1949, the permission was amended to allow the Navy to use Sealion Rock indefinitely, while permission to use the other three coastal islands and rocks was rescinded.

The Navy funded a study conducted by the Washington Department of Game during 1984-85, to evaluate the impact of inert bombing activities on wildlife in the Sea Lion Rock study area which extended from near Pt. Grenville north to Destruction Island. It was bounded on the east by the shoreline and extended out to the west approximately seven kilometers. The primary study area was located between Pt. Grenville and Tunnel Island.

As a result of the study, existing flight patterns were changed to limit all departures to the west to minimize any flights over adjacent islands and rocks (e.g. the flight pattern

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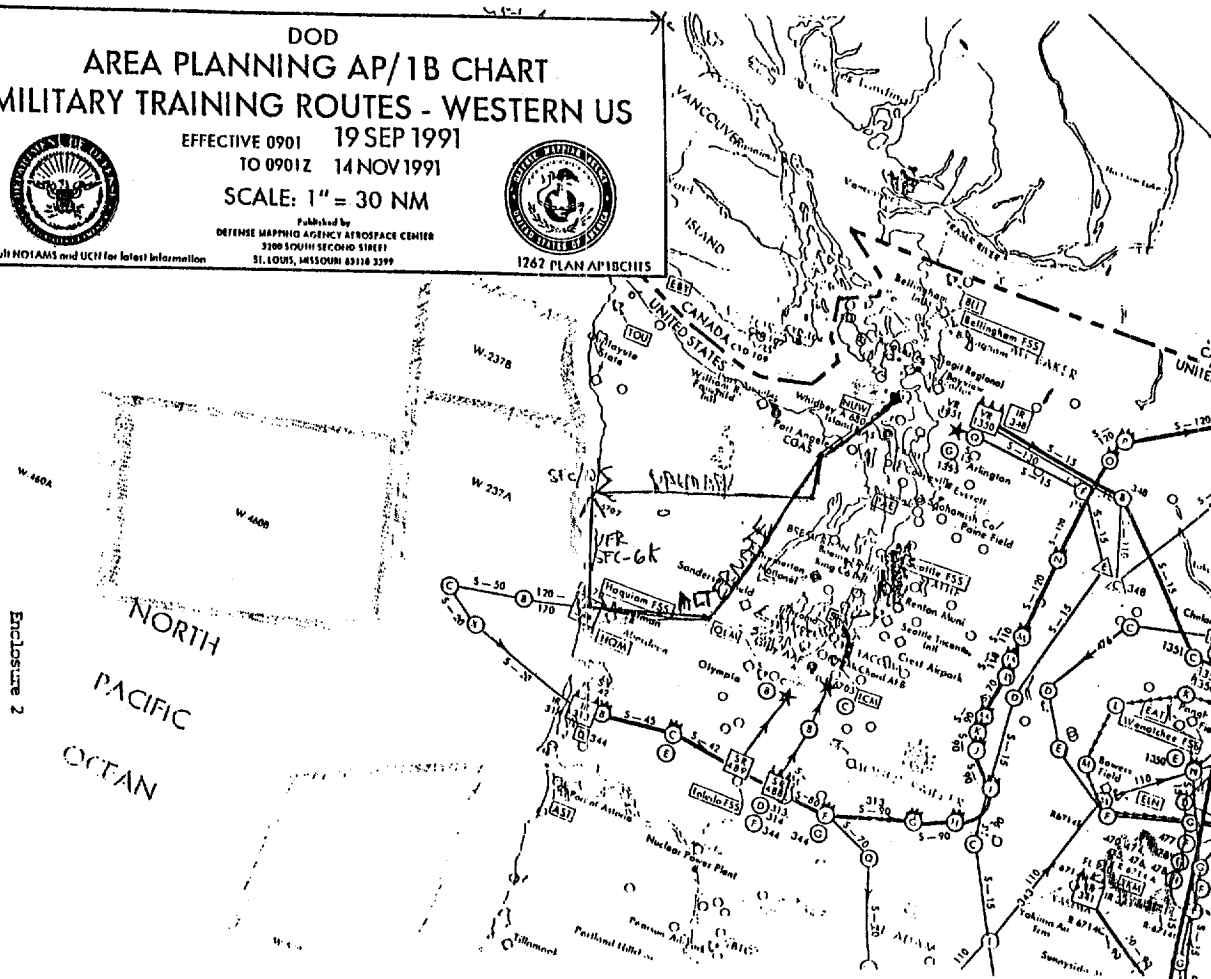
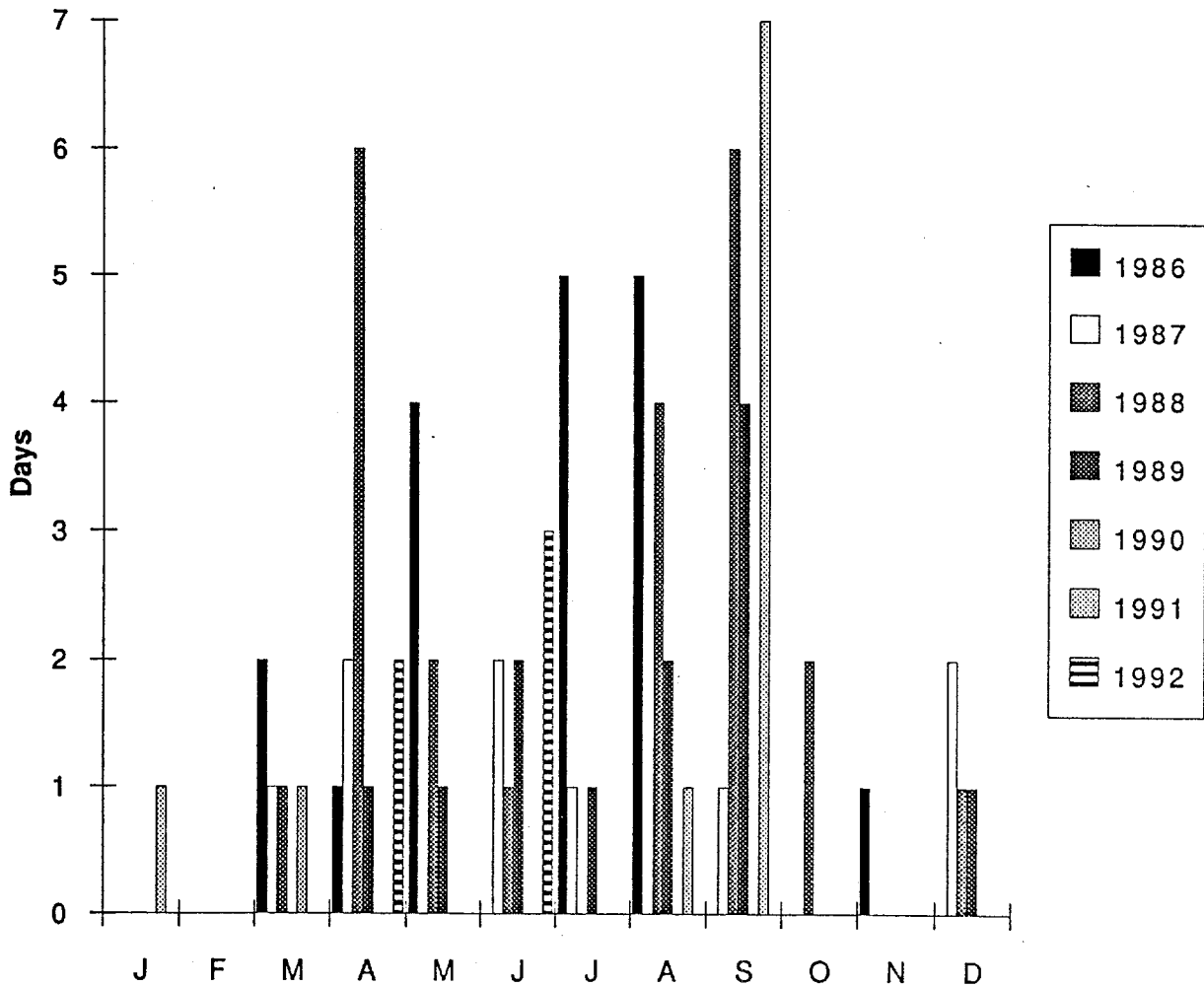


Figure 50.

Flight Paths by Aircraft Transiting from Whidbey Island Naval Airforce Base to R-6707 (Whidbey Island Naval Air Station, 1992)

# NAVY USE OF SEALION ROCK FROM 1986-1992 (DAYS/MONTH)



Source: Whidbey Island Naval Air Station, 1992

Figure 51. Number of Days/Month Navy has Used Sealion Rock From 1986-1990 (Whidbey Island Naval Air Station, 1992).

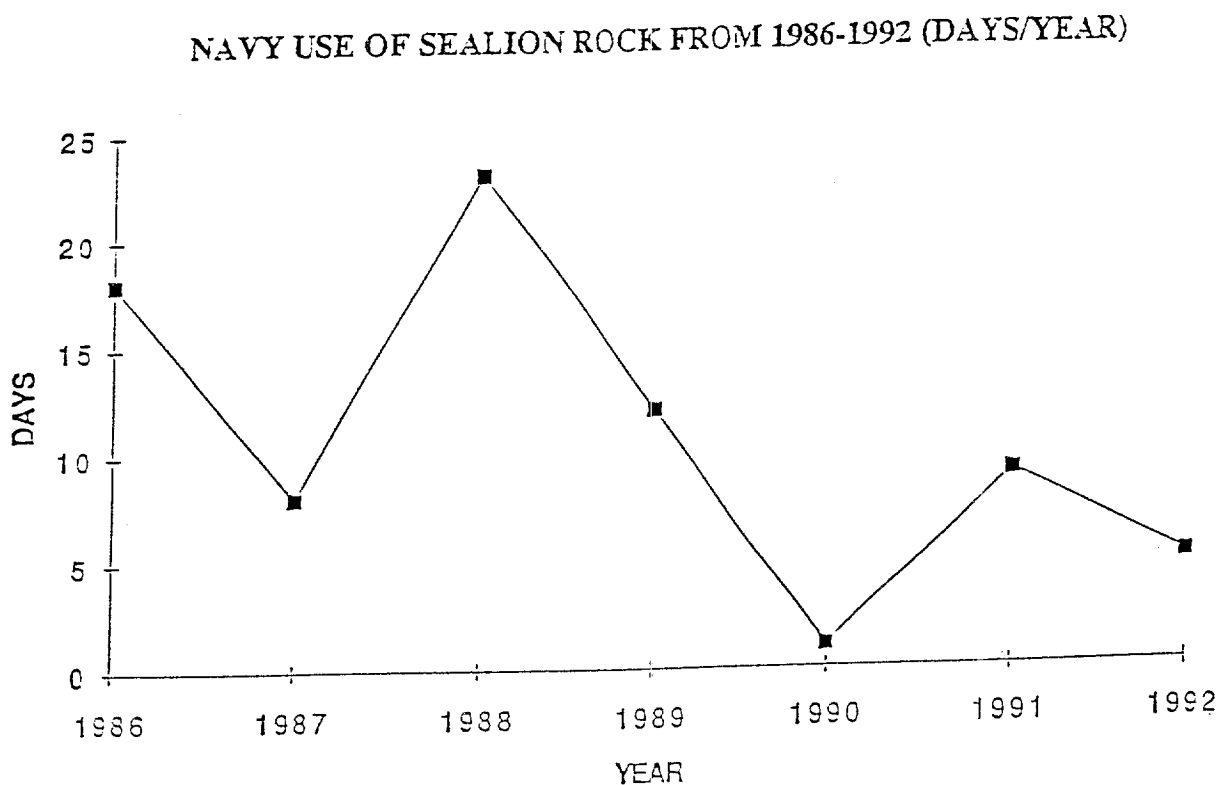


Figure 52. Number of Days/Year Navy has Used Sealion Rock from 1986-1991 (Whidbey Island Naval Air Station, 1992).

was altered to reduce noise levels reaching wildlife habitats on rocks 3.5 miles away). The study also confirmed that nearby Split Rock and Willoughby Rock wildlife habitat areas, 3.5 miles to the South of Sealion Rock, had been mistaken for the target sometime in the past. The study concluded that "A-6 activities conducted in accordance with the Operations Plan (i.e., all departures are to be to the west) result in minimal, and apparently insignificant, impacts on wildlife."

The study's conclusions and methodology, however, have been widely criticized because: 1) the study was conducted during an El Nino year; 2) the study should have conducted population studies of birds and mammals for a much longer period of time to account for variation in environmental conditions; 3) the study did not include an examination of a "no-use" alternative, and thus comparative analysis was absent; and 4) the researchers were unaware of all military overflights in the area during the study, and therefore total impacts of military overflights were not accounted for (Troutman, 1993). The environmental impact of bombing activities under the revised flight operations plan has not been investigated.

Although the Navy agreed to certain mitigating measures requested by USFWS to reduce the impacts of practice bombing activities (increased pilot education, radar monitoring, consultation with the NMFS for purposes of obtaining "incidental take" authorization under the MMPA and the ESA), it would not agree to a seasonal cessation, i.e., during the breeding season, of its bombing activities.

The regional office of the USFWS and the Marine Mammal Commission requested that the Department of Interior either rescind or modify the Navy's permit to prevent bombing during the breeding season for seabirds. The regional office of the USFWS, pursuant to its responsibilities under the Refuge Administration Act, performed a compatibility determination and found that the Navy's use of Sealion Rock was incompatible with the purposes for which the refuge was established. Notwithstanding the regional USFWS office's determination of incompatibility and the Navy's refusal to cease bombing practice during the breeding season, the Director of the USFWS did not rescind the Navy's permit because of national defense considerations.

On October 22, 1992, several environmental groups (Defenders of Wildlife, Natural Resources Defense Council, Inc., National Audubon Society, American Oceans Campaign, the Wilderness Society and Washington Environmental Council) filed suit in the U.S. District Court for the Western District of Washington against the Department of Interior, USFWS and the Navy to enjoin the Navy's practice bombing activities over Sealion Rock. Thereafter, the Navy announced that it would no longer use Sea Lion Rock for aerial target practice. On August 18, 1993 the Secretary of the

Interior rescinded the permit issued in July, 1949 authorizing Navy access to Sea Lion Rock for practice bombing activities. As a result of the Secretary of Interior's action, the Navy can no longer use Sea Lion Rock for practice bombing exercises.

The Navy regards Pacific Fleet operations off the northern coast of Washington as essential to Fleet readiness. Navy environmental protection policy precludes discharge of fuel oil, medical wastes, plastics, and other pollutants into the water, and prescribes immediate containment and clean up procedures in the event of accidental discharge. Fuel dumping by aircraft is also precluded except as necessary for safety of flight, and then only above 6000 feet.

#### 5. Ocean Waste Disposal

Regulation of dumping of materials, including dredged material, into ocean waters falls under sections 102 and 103 of the MPRSA. These sections of the law are jointly administered by the EPA and COE. Responsibility for designation of sites and permitting of disposal other than dredged material has been delegated to EPA Region 10. The COE, in consultation with Region 10, is the permitting authority for dredged material.

Management of ocean dredged material disposal sites, including necessary monitoring, is a shared responsibility between the appropriate Corps district (Portland or Seattle) and EPA Region 10. Dredged material proposed for ocean disposal must comply with criteria in 40 CFR 220-228. In February 1991, the COE and EPA released Evaluation of Dredged Material Proposed for Ocean Disposal: Testing Manual (the Green Book) which provides a framework for testing of dredged material. Many of the techniques described in the Green Book have been standard practices in Region 10 for several years. Based on past and current testings of dredged material disposed in open water and monitoring at open water sites, no significant adverse environmental effects have resulted from past or ongoing disposal (Findley, 1991).

The regulation of point source discharges in Washington through EPA NPDES permits is the responsibility of the WDOE. NPDES permits for tribes, however, are granted directly from EPA. WDOE classifies the waters of the state into different categories. Washington's coastal waters are classified class AA which is the highest water quality rating. The waters in the estuaries of Grays Harbor and Willapa Bay are classified class A, a slightly lower water quality rating.

Because of the undeveloped nature of land adjacent to the sanctuary study area, it is a relatively unspoiled area. Pollution from traditional sources (e.g., wastewater treatment plants, industry and urban runoff) is very low. Drainage areas

which eventually feed into the sanctuary study area are shown in Appendix C (Map 3). There are no major industrial dischargers within the study area. There are seven major dischargers that discharge adjacent to study area 7 including two pulp mills, two sewerage systems, and three seafood processing plants (Appendix C, Figure 3, Tables C1-C4). Pesticide use is very low relative to other areas of the U.S. west coast (Appendix C, Figure 4). Except for inputs of "total suspended solids" from paper mills, the greatest source of suspended solids in the sanctuary watershed is from non-point source runoff from forest land.

(a) Point-Source Discharges

Based on information collected in 1985 by NOAA's National Coastal Pollutant Discharge Inventory Program, there are 72 point source discharges in the watersheds draining into the sanctuary study area (Appendix C, Table C1). Fifty-six of these are industrial or commercial dischargers; sixteen are wastewater treatment plants (WWTS). Five of the fifty-six industrial/commercial dischargers are classified as major dischargers. Two are large pulp and paper mills discharging to the Grays Harbor estuary, and three are seafood processing and canning plants. Two of the seafood processors discharge to Willapa Bay, while the other discharges to Grays Harbor.

The two pulp mills discharging near the study area rank in the top half of the 21 major pulp, paper and paperboard mills on the west coast with respect to pollutant discharges. They rank seventh and ninth out of 21 facilities with respect to volume of wastewater discharged, and fourth and sixth out of 21 plants with respect to discharge of oxygen demanding materials.

Of the nine major seafood processors discharging to the U.S. west coast, the plants discharging near the study area are the top three in terms of volume of flow and oxygen demanding materials discharged. The DOMSEA Farms plant in Rochester is the most important seafood processor on the West Coast in terms of discharges.

Only two of the fourteen WWTPs are classified as major facilities. Both discharge into the Grays Harbor watershed. Relative to other major WWTPs on the west coast, these are very small dischargers.

A tribal sewage treatment plant on the Makah Reservation presently discharges primary treated wastewater into the Waatch River. The National Fish Hatchery discharges recycled water into the Tso-Yess River. The Makah are planning to upgrade their treatment facilities by either creating a lagoonal treatment system on land which would achieve at a minimum secondary treatment, and during low usage times of the year, tertiary treatment or repairing their discharge pipe and discharging into

the Strait of Juan de Fuca just east of Koitlah Point.

The sewage system at Taholah on the Quinault reservation is near capacity utilization. Sewage lagoons at Queets are threatened with erosion from the nearby Queets River.

Sewage disposal on the Hoh reservation is via septic tank and is considered inadequate. The Tribe is evaluating a more systematized treatment process. Solid waste is now transported to Sequim, east of Port Angeles. This procedure is considered expensive and alternatives are being sought.

The sewage system on the Quileute Reservation is in desperate need of repair. The collection system consists of approximately 12,100 ft. of gravity sewer, 3,900 ft. of forcemain, and three pump stations. The treatment system is biological and consists of three mechanically aerated concrete cell/lagoons, a gas chlorination contact chamber, and discharge to a beach drainfield. The community sewer system is operational even though many of the system components are no longer functional. The system is presently being operated manually as many of the automatic controls are non-functional. The system has a history of failures due to malfunctioning equipment and/or deterioration from salt air corrosion. Overflows have occurred to the boat basin and in the street. High water and rough ocean wave action has caused exposure of pipes in the drain field. It is postulated that the beach drainfield has damaged the once existing razor clam beds (Schafftlein, 1992).

The Quileute Tribe is in the process of hiring a consulting firm to develop a wastewater facility plan. The plan will analyze the existing sewage system and provide recommendations and cost estimates for improvements to the sewage collection, sewage treatment, and sewage disposal systems. Particular areas of concern include; sludge handling and disposal, identification of the most appropriate sewage treatment and disposal methods, and reduction of present operations and management burdens.

#### (b) Non-Point Source Discharges

The greatest source of non-point source discharge is runoff from forest lands (Appendix C, Figures 5-7). The coastal counties adjacent to the proposed sanctuary study area (areas 4 and 7) may be characterized as having relatively minor agricultural activity, with an average agricultural acreage by county of only 3.6%. The major crops, excluding pasture/range, are alfalfa, barley, corn, wheat, and peas. According to NOAA's National Coastal Pollutant Discharge Inventory, which maintains a data base of estimates of pesticide use for 28 commonly applied agricultural pesticides, the highest application of pesticides by county for areas 4 and 7 occurs in Grays Harbor county, with 6,836 pounds (base year of 1982). This is a relatively low

amount compared to a major agricultural area such as San Joaquin county in California (98 percent agricultural), where an estimated 658,000 pounds of the 28 agricultural pesticides were applied. As is typical with most pesticide application, herbicides make up the majority of the amount applied in the sanctuary area. It should also be noted that Clallam and Jefferson counties extend inland to Puget Sound, thus the total amount of agricultural pesticides applied in drainage areas feeding the waters of the sanctuary study area is probably less than the estimates above which use whole county figures.

(c) Ocean Dumping of Industrial and Dredge Material

Although no ocean dumping currently takes place within the proposed sanctuary, the coastal and offshore waters of Washington have been used for the disposal of various materials. Low-level radioactive wastes were disposed of prior to 1970 at several sites over 300 miles northwest of Cape Flattery, well outside of the proposed sanctuary study area. This dumping was discontinued in 1970. Explosives and toxic chemical munitions have been dumped in the past at one site 66 miles and another site 34 miles west of Cape Flattery.

Industrial wastes have been dumped at two sites off Cape Flattery. One site, located within the boundaries of the proposed Olympic Coast National Marine Sanctuary, was only 5 miles from shore; the other, located outside the boundaries, was 75 miles offshore. An exhaustive search of the literature and records of the EPA and COE to determine exactly when and what materials were dumped at these sites yielded nothing more definitive than information included in a report prepared for EPA by a private contractor entitled Ocean Disposal of Barge and Solid Wastes From U.S. Coastal Cities (Smith and Brown, 1971). Although the report does not specify the types and quantities of wastes dumped at the site, it indicates that the wastes were classified as industrial, which could include refinery wastes, spent acids, pulp and paper mill wastes, chemical wastes, oil drilling wastes, and waste oil and sewage sludge. There is no indication as to when the wastes were dumped. However, given that the report only includes sites active during the period 1951 to 1971, it can be assumed that industrial wastes were dumped sometime during that period.

Information on these dumpsites from NOAA Hazmat, EPA and the COE is limited because much of the documentation the Corps maintained on marine waste dump sites in the Pacific Region was lost/destroyed during the transfer of the ocean dumping program from the COE to EPA in the early 1970s. The regional COE office has indicated that it is unaware of any dumping activity occurring off the Washington Coast between the years 1971 and 1988.

Dredged material is the only material currently being dumped in coastal waters. Spoils from the maintenance dredging of Grays Harbor are deposited near the entrance to the harbor where they are flushed out by tidal currents. Spoils from dredging of the Columbia River are dumped at the mouth of the river and at three sites located two to four miles offshore. The annual average amount of dredged material disposed off the mouth of the Columbia River exceeded 5 million cubic yards per year between 1974 and 1987. The dredged spoils from a proposed major channel deepening project at Grays Harbor are proposed to be deposited at three sites: the current maintenance site near the harbor entrance, a site 3.9 nautical miles offshore and to the southwest west of the harbor entrance (Southwest Navigation site), and a site 7.1 nautical miles offshore and west-northwest of the harbor (Eight-Mile site). These latter two sites were officially designated by EPA Region 10 as ocean disposal sites for dredged materials, effective August 6, 1990 (FR, Vol. 55. No. 129, July 5, 1990, pp. 27635-8cv).

## 6. Hard Mineral Extraction

Under the Outer Continental Shelf Lands Act of 1982, as amended, the Department of the Interior is charged with administering the mineral development of the OCS. The Secretary of Interior is authorized to lease any minerals, other than oil, gas, and sulphur, on the OCS on the basis of competitive bonus bidding. The Secretary also has the responsibility for the design, implementation, and management of OCS minerals development. In the U.S., industry interest in OCS mining has been focused on eight heavy metal placers, strategic minerals, sand and gravel, and phosphate. Furthermore, gold is being recovered in State waters near Nome, Alaska, and sand and gravel in New York State Waters.

Marine mineral resources known to exist along the outer coast of Washington include gravel and titaniferous black sands. To date, there has been no production of these offshore minerals in either state or federal waters.

Gravel deposits are found in Federal waters from Cape Flattery to Grays Harbor, with large deposits concentrated off Cape Flattery and offshore from the Hoh, Quinault, and Chehalis Rivers. Gravel at depths of less than 50 meters can be mined with a suction dredge. Lasmanis (1988) estimates that at least 144 million cubic yards of gravel exist at this depth or shallower, and these deposits have the highest potential of any offshore minerals for exploitation by the year 2000.

Titanium and iron-rich black sand deposits are found south of the proposed sanctuary. Large deposits have been found from the intertidal areas out to two miles from shore near the mouth of the Columbia River and off of Willapa Bay. Sands have also

been found at Copalis and Moclips that contains minor amounts of gold. It is unlikely that mining these sand deposits will be economically viable in Washington waters within the next 20 years.

The only mineral-related activities that have taken place in state waters have been the exploration for and attempted development of the black sands. Five companies have been involved in commercial activities: National Lead Company explored in Grays Harbor in 1949; NARECO, Inc. explored near the mouth of the Columbia River in 1959; Washington Mineral Products, Inc. and Beach Mining, Inc. explored in the Cape Disappointment area; and Columbia Ocean Minerals, Inc. explored off Benson Beach and Ilwaco in 1986.

Onshore production of gold from beach sands did occur from about 1894 to 1908 on a strip of beach from 10 miles south of Cape Flattery to 6 miles south of the mouth of the Ozette River (Weissenborn and Snively, 1968). Presently, no onshore mining is occurring in these counties except at Twin River quarry on the Strait of Juan de Fuca.

#### 7. Overflights

All aircraft flying over the Sanctuary can legally fly unrestricted. When there are military operations within the MOA over the Peninsula, non-military airplanes stay below 1,200 feet. Most aircraft that land at airports on the Peninsula (Sekiu, Quileute, Copalis) are small recreational airtaxi or commuter planes.

The 1992 statistics compiled by the Federal Aviation Administration (FAA) indicate that the total number of operations (landings and takeoffs) at the Quileute Airport for a 12 month period ending July 18, 1992 totalled 4,800. Included in this statistic is one scheduled cargo plane per day 5 days per week. There were 2,600 operations recorded at the Sekiu airport for the 12 months ending March 20, 1991. Copalis Airport, located on the beach is accessible only at low tide and could be closed due to obstruction from drift wood. There are an estimated 300 operations at Copalis Beach per year with most planes recreational or chartered flights that land on the beach for short periods of time.

Other overflight activity over the Sanctuary include those engaged in enforcement activities (USCG) and marine mammal and seabird monitoring efforts conducted by the NMFS and the USFWS.

#### 8. Research and Education

Although the diverse habitats and pristine nature of the outer coast provide outstanding opportunities for scientific

research and education, much of the area has not been studied in detail. The 60 mile stretch of shoreline within Olympic National Park is virtually unstudied despite its relative accessibility (Dethier, 1988). Research programs have been and are being conducted by several universities, the USFWS, NPS, NOAA's NMFS, and the Northwest Indian Fisheries Commission (NWIFC). This research has provided valuable baseline data on the resources present and on the impacts associated with recreational uses and potential offshore oil and gas development.

Researchers with the NPS surveyed the invertebrate and algal species associated with intertidal zones, and monitored the recreational impacts on intertidal biotic communities at three sites along the Pacific Coastal Area of the Olympic National Park (Kendrick and Moorhead, 1986). The University of Washington has conducted research on the biological and oceanographic characteristics of the coastal and offshore waters of the outer coast. Dethier (1988) studied and classified the marine habitats along the Pacific coastline of Olympic National Park and gathered baseline data on abundances and diversities of the biota in these habitats. Permanent transects were set up across four intertidal areas to allow for periodic monitoring. Landry and Hickey (1989) present the results of research sponsored by the Department of Energy (Washington Sea Grant is sponsoring the publication of results) on the physical, chemical, geological, and biological processes occurring on the continental shelf off of these two states.

Western Washington University (Terich and McKay, 1988) researchers studied transport along the coastline of Olympic National Park. Using a sediment budget approach, the researchers studied the shoreline as a sediment system, with sediment sources, sinks, and exchanges.

In anticipation of the planned Federal oil and gas lease sale 132, the State of Washington appropriated \$400,000 to Washington Sea Grant and requested that they conduct studies that would enable the State to be better able to address the issues associated with potential oil and gas development off its shores. The resulting Ocean Resources Assessment Program (ORAP) synthesized existing information from past and current studies, including the research mentioned above. Projects funded under ORAP provide information on data gaps and research needs, state and local influence over offshore oil decisions, the oil and gas potential of the Washington OCS, and a conceptual framework for guiding future OCS research.

The NWIFC provides technical and coordination support to the Washington Indian tribes in the management and preservation of fishery resources. The NWIFC conducts a salmon and steelhead tagging program, and conducts annual and long-range fish harvest planning and catch monitoring programs.

NPS interpreters conduct guided walks to the numerous tidepools at several locations in Olympic National Park, including Starfish Point near Kalaloch, and Hole-in-the Wall near Rialto Beach.

MMS, Pacific OCS Region, has contracted for numerous studies to support the Environmental Studies Program. Some of the most recent studies, and their current status as of June, 1990 are:

Monitoring of Olympic National Park Beaches to Determine Fate and Effects of Spilled Bunker C Fuel Oil; Dept. of Energy; Active.

Inventory and Evaluation of Washington and Oregon Coastal Recreation; NPS; Active.

An Evaluation of Spawning and Recruitment Patterns of Fishes off N. CA, Oregon, and Washington; IA-NOAA; Active.

Biological Impacts of Translocated Sea Otters; Univ. of Minnesota; Active.

Effects of OCS Oil and Gas Production Platforms on Rocky Reef Fishes and Fisheries; Marine Research Specialist; Active.

Potential Social and Economic Effects of OCS Oil and Gas Activities on Oregon and Washington Indian Tribes; Central Washington University; Active.

Conference/Workshop on Recommendations for Studies in Washington and Oregon Relative to Offshore Oil and Gas Development; Bio/Tech Communications; Completed.

Coastal Circulation Along Oregon and Washington; Envirosphere Company; Completed.

Summary and Analysis of Environmental Information of the Oregon and Washington Coastal Zone and Offshore Areas; Univ. of Washington; Completed.

Workshop: Recommendation for Baseline Research in Washington/Oregon Relative to Offshore Resource Development; Research Triangle Institute; Completed.

## 9. Protected Areas

Most of the offshore rocks and islands are included in three National Wildlife Refuges: Quillayute Needles, Flattery Rocks, and Copalis. All three refuges, established by Theodore Roosevelt on October 23, 1907 by Executive Order 704, are managed and maintained by the USFWS. They were established as a place

"...reserved and set aside for the use of the Department of Agriculture (now Interior) as a preserve and breeding ground for native birds and animals." (Executive Order 704, October 23, 1907). Refuge system goals are fivefold:

- 1) To preserve, restore, and enhance in their natural ecosystem (when practicable) all species of animals and plants that are endangered or threatened with becoming endangered;
- 2) To perpetuate the migratory bird resource;
- 3) To preserve a natural diversity and abundance of fauna and flora on Refuge lands;
- 4) To provide an understanding and appreciation of fish and wildlife ecology and humankind's role in the environment, and to provide Refuge visitors with high quality, safe, wholesome, and enjoyable recreational experience oriented toward wildlife to the extent these activities are compatible with the purposes for which the Refuges were established; and
- 5) To support the Regional Resource Plan and Regional Marine Bird Policy.

Pursuant to the Wilderness Act of 1964 (Act of September 3, 1964; P.L. 88-577, 78 Stat. 890, 16 U.S.C. 1131, et seq.) the Refuges were designated as Wilderness areas on October 23, 1970, except for Destruction Island which was excluded because of Coast Guard facilities on the island. Additionally, most of the coastline within the Olympic National Park and north of the Hoh River was designated as Olympic Park Wilderness in 1988. The Quinault Indian Nation has designated most of the coastal area within the reservation as a Wilderness Area, which includes a prohibition on the development of land. Classification of areas as "wilderness" results from individual Acts of Congress to roadless lands managed by the Departments of Agriculture or Interior. Wilderness is the most protective form of designation that can be applied to Federal resource lands. The Wilderness Act stipulates that management of designated areas should be such as to "leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas,..." To this end, the Act generally prohibits any construction of roads or facilities, any use of motorized vehicles, motorized equipment or motorboats. The Act recognizes that "[a] Wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain." The definition lists as one of an area's attributes that it "has outstanding opportunities for solitude or a primitive and unconfined type of recreation." (Siehl, 1991).

Except for the USCG, only those who have a permit from the USFWS may visit the offshore islands. Pursuant to an MOU between

the USFWS and the USCG, the USCG may visit Destruction Island to service and maintain the lighthouse and buildings during the non-nesting season. Other than the USCG activities, use of the islands is limited to wildlife surveys conducted by the USFWS.

Olympic National Park includes much of the shoreline, the offshore refuge islands in the Flattery Rocks and Quillayute Needles including adjacent intertidal habitat to the lower low tide, rain forests, and mountains of the Olympic Peninsula. It is managed by the Department of the Interior, NPS. The Park was designated a Biosphere Reserve by UNESCO in 1976 and as a World Heritage Site by UNESCO in 1981 based upon an evaluation by the International Union for the Conservation of Nature. The objectives of Biosphere Reserves are:

- 1) to conserve for present and future use, the diversity and integrity of biotic communities of plants and animals within natural ecosystems, and to safeguard the genetic diversity of species upon which their continuing evolution depends;
- 2) to provide for ecological and environmental research including baseline studies, both in and adjacent to these reserves, such research to be consistent with objective (1) above; and
- 3) to provide facilities for education and training.

#### 10. Recreational Activities and Tourism

The rugged, pristine environment and variety of habitats found along the Olympic Coast with its abundant natural resources provides ample opportunity for recreation for both residents and tourists. The Washington outer coast is an isolated area that has always depended on its natural resources for its economy, including tourism. Recreational activities include fishing, clamming, camping, hiking, whale-watching, boating, sightseeing, beachcombing, and diving.

In 1984, there were 95 public recreation areas in Clallam and Jefferson counties and 78 in Grays Harbor and Pacific counties. Most of these areas are small areas managed by local governments, but the Federal government manages most of the acreage because of the large national parks, forests, and wildlife refuges. In 1984 there were over 1.2 million acres of public recreation land in Clallam and Jefferson counties and over 185,000 acres in Grays Harbor and Pacific counties. Over 99.6% of the acreage in Clallam and Jefferson counties and 92.6% of the acreage in Grays Harbor and Pacific counties was managed by the Federal government.

Recreational fishing takes place from charter boats, skiffs,

jetties, sandy beaches, and rocky shores. Figure 41 (p. 95) shows the more intensively fished offshore recreational fishing areas for salmon and bottomfish. The ocean recreational fishery for salmon operates primarily out of Westport, Ilwaco, La Push, and Neah Bay. The charter boat industry is centered at these ports with Westport being the most popular location for ocean salmon fishing north of the Columbia River (Squire and Smith, 1978). In 1986, the NMFS estimated that 295,000 recreational fishermen did saltwater fishing in the state of Washington. About 16% of the recreational fishing trips were taken in Washington, resulting in recreational harvest of over 9 million fish. About 11% of all trips and 22% of all catch in Washington, Oregon and California takes place in Washington. Over 60% of all trips and catch are by boat modes.

The decline of the salmon stocks in recent years has also caused a major decline in the charter fishing business. The number of charter fishermen has dropped from half a million in 1977 to a low of 40,000 in 1984, while the number of charter boats has dropped from 228 to 60 (Strickland and Chasan, 1989). The charter boats remaining now emphasize bottomfishing and whalewatching in addition to trolling for salmon. Black rockfish and lingcod are the main species caught, with other species of rockfish, cod, halibut, and flounder also of importance. Charter trips for bottomfish in 1987 totalled 1,686 from Ilwaco, 21,381 from Westport, 452 from La Push, and 21,058 from Neah Bay (ibid.). The reduction in charter boat fishing is corroborated by the reduction in fishing trips for party/charter boats reported by the NMFS for all of Washington. From 1979 to 1986 party/charter boat trips in Washington dropped about 42% (45,000 trips in 1979 to 26,000 trips in 1986). However, total saltwater recreational fishing trips increased over 23% from 1979 to 1986. Trips by private/rental boats increased over 55%, while shore based fishing trips increased over 26%.

Facilities at La Push and Westport rent skiffs and boat-launching facilities. La Push is the only small-boat harbor along the coast between Grays Harbor and Neah Bay. Additionally, the harbor is the only place in the area where offshore small-boat fishing is possible with some degree of safety. Chinook, coho, and pink salmon, as well as rockfish, lingcod, greenling, flounder, halibut, and jack mackerel are all caught off La Push. The area north of La Push to near Cape Alava experiences little ocean and shore recreational fishing because of its remoteness from any small-boat harbor and lack of shore access roads. However, boats from Neah Bay frequent the area off Cape Alava and northward to reap the benefits of the coastal salmon resources.

Sandy beach and rocky shore fishing is popular at many sites where access to shore is possible. Surf fishing on sandy beaches at places like Mukkaw Bay yield redbait and striped surfperch, flounder, and halibut. Surf smelt and night smelt are caught

with dip nets along the shore between Kalaloch and the Hoh River during the summer months. Shore fishing from rocky areas is excellent for rockfish, lingcod, and kelp greenling. Fishing from the jetties at La Push and Westport produces redbtail surf perch, starry flounder, black rockfish, greenling, lingcod, and cabezon. Large numbers of coho and chinook salmon are caught from the south jetty at Westport (Haw and Buckley, 1971).

Razor clams are the most important shellfish harvested recreationally on the outer coast. Their harvest, however, has dropped dramatically in recent years. An average of about ten million razor clams was harvested annually from 1950 to 1980. The harvest averaged only four million clams annually between 1981 and 1987, with the season being closed entirely because of NIX virus during 1984 and 1985 (Butts, 1988). Hardshell clams (native littleneck and manila clams) are harvested from Willapa Bay, Grays Harbor, and Hoh Head. Oysters and mussels are also harvested: oysters from Grays Harbor, and mussels from rocky areas north of Moclips (WDF, 1983). Dungeness crab are taken recreationally by wading in intertidal lagoons along the coast, and by ring nets and crab pots in Willapa Bay and Grays Harbor.

Recreational divers, primarily using SCUBA, harvest both shellfish and finfish. Dungeness and red rock crab are the main shellfish taken, while black rockfish and lingcod are the favorites for spearfishing (Bargmann, 1984).

Because many of the wilderness beaches on the outer coast are accessible only by foot, they have become increasingly popular for hiking, camping, and beachcombing. The three most popular areas for beach hikes are between the Hoh River and La Push; north of La Push to the Ozette Ranger Station above Cape Alava; and from Cape Alava to Shi Shi beach just south of the Makah Indian Reservation (Washington Public Shore Guide, 1986).

Olympic National Park is a major tourist attraction of the Pacific Northwest. There were 3.36 million visits to the Park in 1988 (Strickland and Chasan, 1989). The 60 miles of wilderness coast within the National Park have approximately 800,000 visits each year (NPS, 1989). A summer 1989 survey of the coastal areas of Olympic National Park (Leeworthy, Schroefer, and Wiley, 1990) found that 46% of the visitors to the park were out-of-state visitors. On average, visitors to Olympic National Park travelled 1,050 miles from their homes to visit the park compared to 452 miles for all other sites surveyed on the west coast. Per person trip expenditures were over \$700 resulting in a direct economic impact associated with trips to the coastal areas of Olympic National Park of over \$560 million in 1989.

A major visitor/interpretive center is planned by the NPS at Kalaloch. The center will provide exhibits and audio/visual and interpretive programs that will emphasize the wilderness nature

of the coastal beaches and serve as a learning center for visitors and students.

The WDNR manages beaches on the outer coast that are open to the public. The Washington State Parks and Recreation Commission manages state parks on the coast that include public camping and picnic areas. Public beaches and campgrounds between Grays Harbor and Cape Flattery are shown in Figure 25. Islands within the National Wildlife Refuges are closed to the public.

The Strait of Juan de Fuca offers popular recreational diving areas. A wreck located off Tongue Point is accessed by Clallam County Park facilities at Observatory and Tongue Points. Recreational divers can access the Strait directly from shore from these parks. The Washington Department of Natural Resources supports a park at the Lyre and Pyscht Rivers. Boating and fishing are popular recreational activities in the Strait as well. There are very few access points to the public beaches along the Strait by boat or shore.

PART III: Alternatives Including the Preferred Alternative